Glaucoma in the Elderly

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Case Vignette

An 85-year-old Caucasian man presents for evaluation after an increased intraocular pressure was detected at a community screening for glaucoma. He has a past medical history of severe degenerative arthritis in his hands and suffers from stable angina. Though a widower, he lives independently near his family; he has declined previous suggestions to move in with them or to the local retirement center. On examination, the patient has 20/20 visual acuity OU, an increased intraocular pressure (IOP) of 28 mmHg OU, and glaucomatous cupping of 0.9 OU. Both a confrontation visual field and formal perimetry show a superior arcuate glaucomatous defect OU. At that point, his eye doctor begins a one-eyed trial in the right eye (OD) of timolol GFS 0.5% each morning.

On follow-up evaluation, the patient reports perfect compliance. He reports intermittent blurred vision after placing the new medication. He mentions also a baseline intermittent dizziness due to low blood pressures. On

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further questioning, he thinks this may be increased with the new therapy. Although he last placed the timolol at 7:00 AM, his intraocular pressures on examination are unchanged and still elevated as during his initial appointment and are equal OU. After questioning, he confirms lid closure and punctual occlusion for 5 min after each drop.

His daughter is present for the current exam and reports that she has witnessed the patient both remembering to take his medication and instilling the drops. When asked to apply an additional drop in the office, the patient elevates his eyes, positions and squeezes the bottle, closes his eyes, and correctly applies correct punctual occlusion. The patient and his daughter are unaware that the process failed to squeeze a drop out of the bottle and into the eye.

Patient Care

The patient care competency includes the use of preventative care for populations as well as individuals. Treatment and prevention start with diagnosis. We know that the incidence and prevalence of glaucoma increase with advancing age, but because it is often asymptomatic until advanced, the disease can have devastating visual and functional consequences by the time of diagnosis. Glaucoma-related vision loss negatively affects the quality of life and activities of daily living in the elderly, an ever-increasing population in the United States. The elderly are currently increasing at more than twice the rate of the general population; the population over 85 years of age is projected to be 7 times larger in 2050 than it was in 1980. Glaucoma currently affects 2.2% of Americans over age 40 and 7.7% of individuals over age 80. The total number of patients with glaucoma is thus projected to increase by 50% by 2020 [1, 2].

The likelihood of developing glaucoma is affected by race as well as age. Glaucoma is the primary cause of blindness for African-Americans and is three to four times more common than in non-Hispanic whites. This risk is higher still in black patients originating outside of the United States. Other races are increasingly being recognized at increased risk for glaucoma as well. Glaucoma is found in up to 22% of Latinos over age 80 and causes 28.6% of all blindness in the Latin American population. The repercussion to the US population is significant: in the 2010 Census, 50.5 million individuals (16.3% of the population) identified themselves as Latino or Hispanic [2–5].

There is a role for screening at risk populations for eye disease (Fig. 1). Ten percent of the elderly have undiagnosed visual disorders and could benefit from screening. Up to a quarter of patients, over 80 with vision loss are unaware of their disease, including 7% who are blind from their disease [1, 2]. Compounding this problem, elderly patients with decreased vision may overestimate the quality of their vision, decreasing the likelihood that they will seek ophthalmic evaluation and care [6].

Fig. 1 Application of ophthalmic drops to facilitate examination

Institutionalized Americans are at a higher risk, with current estimates showing 26% of nursing home residents to have visual impairments [7]. Although half of glaucoma patients in America are undiagnosed, that number increases as high as 75% in Latin Americans for both open-angle glaucoma and for ocular hypertension [5]. There is potential benefit in screening the general elderly population for common diseases such as glaucoma in order to prevent vision loss and the comorbid conditions that accompany the loss of sight. There is increasing attention to performing this vision screening at sites where the elderly frequent, such as senior living facilities, activity centers, and outpatient clinics. These screenings may be performed by traveling nurses. Tonometry is currently one of the recommended means of glaucoma screening. Tonometry can be accomplished with light and inexpensive equipment performed by minimally trained non-ophthalmic personnel but is still underutilized as a glaucoma screening tool [1]. The benefit of public health screening has been studied and has support in the literature [1, 6], but the effect on the rates of vision-related functional impairment and effect on quality of life has been debated. The US Preventive Services Task Force (USPSTF) literature review (2005) found insufficient evidence to recommend for or against screening adults for glaucoma. The USPSTF found "good evidence that screening can detect increased intraocular pressure (IOP) and early primary open-angle glaucoma (POAG) in adults," and "early treatment of adults with increased IOP detected by screening reduces the number of persons who develop small, visual field defects." They agreed that "early treatment of those with early, asymptomatic POAG decreases the

number of those whose visual field defects progress" but felt that the overall evidence was not sufficient to determine the "extent to which screening – leading to the earlier detection and treatment of people with IOP or POAG – would reduce impairment in vision-related function or quality of life" [8]. This has led to debate, encouraging screening specifically by eye care professionals. In response to the USPSTF paper, the American Academy of Ophthalmology (AAO) produced a response emphasizing the new evidence for screening and the importance of the role of eye care professionals in screening. The summary of the letter is below:

1. *There is, in fact, a clear chain of evidence that connects glaucoma screening by eye care professionals with meaningful preservation of visual function and quality of life, through the reduction of worsening of glaucoma.*
2. *Community glaucoma screening will result in detection of patients with meaningful loss, since most will already have significant visual field loss in excess of − 4 dB.*
3. *Visual field loss at the − 4 dB level has a demonstrable and clinically significant impact on patient visual functioning and vision-related quality of life.*
4. *There is documented cost-effectiveness from the societal perspective in treating this level of visual field loss.*
5. *Glaucoma screening, defined as including an eye examination that detects all other conditions that threaten sight in the elderly and thus will result in significant benefit for older Americans in key indicators as important as IADL's and ADL's* [9] (Fig. 2).

Fig. 2 Confrontation visual field testing

The question of the cost-effectiveness in treating glaucoma is a significant one. The direct economic cost of glaucoma to the United States is $2.86 billion annually for doctor, hospital, and drug treatment fees [2]. This estimate does not address the indirect costs of lost productivity, loss of quality of life, depression, institutionalization, and comorbid injury from falls and accidents. Although the geriatric population is already at risk of falling from comorbid medical conditions, glaucoma adds a significant risk for injury and falls. The loss of peripheral vision, particularly loss in the inferior visual fields, increases the likelihood that a patient will run into objects while walking and increases the need for home modification and environmental analysis training [7]. Haymes et al. found glaucoma patients to have a threefold increase in annual falls and a sixfold increase in motor vehicle accident (MVA) in the preceding 5 years compared to controls. Glaucoma patients who suffered an MVA were sevenfold more likely judged at fault [10]. The Salisbury Eye Evaluation study found visual field loss to be the primary visual indicator of an increased risk of falling [11]. Several studies have shown binocular visual field loss to be associated with a significantly increased risk of motor vehicle accident [11, 12]. Adequate glaucoma treatment, maximal vision correction and rehabilitation, and fall prevention could decrease both the personal and the social costs of glaucoma in our aging population.

Patient-centered care also applies to the individual and should be considered when performing diagnostic testing on the elderly glaucoma patient. Goldmann applanation and formal visual field testing, though gold-standard in glaucoma evaluations, have limited utility in patients unable to position comfortably at a slit lamp or visual field perimeter. In addition to physical limitations, even mild cognitive decline can affect visual field results [13]. Assessing the patient as a whole, including both their physical and cognitive limitations, results in a tailored work-up that is more comfortable to the patient and more revealing of true visual deficits and changes for the physician (Fig. 3).

Fig. 3 Formal Humphrey visual field testing

Medical Knowledge

Glaucoma is a significant visual disorder that affects the gamut from first-world to third-world nations. The World Health Organization projects 80 million people to be affected by glaucoma worldwide by 2020, and a recent Cochrane meta-analysis estimates those numbers will climb to over 110 million by 2040 [14]. The worldwide ratio between open-angle and angle-closure glaucoma is approximately 3:1. Of these patients, most bilateral glaucoma blindness in the world is due to angle closure. The overall incidence of glaucoma begins above age 40 and increases sharply with age [15]. The reach of glaucoma as a major cause of vision impairment extends to first-world nations and accounts for 10% of blindness in the United States. In the United States, one million elderly over the age of 65 have vision loss from glaucoma, and 75% of those legally blind from glaucoma are over the age of 65 [3].

The elderly at risk for glaucoma are also at increased risk of drug toxicity following treatment for glaucoma (Table 1). Although glaucoma medications are primarily applied as topical drops, those drops are adsorbed systemically through the conjunctiva and the nasal mucosa. Drugs administered via the mucosa directly enter the bloodstream without undergoing first pass elimination in the liver. The systemic effective dose of these medications is therefore larger than a similar oral dose. All medications have an increased potential for side effects in the elderly patient. The elderly have a lower muscle-to-fat ratio, less cardiac output, and less effective renal and liver clearance. Older patients have more comorbid medical conditions, including chronic obstructive pulmonary disease (COPD), diabetes, hypertension, cardiac arrhythmias, congestive heart failure, and arthritis that can be adversely affected by the use of topical

Table 1 Side effects of glaucoma medication [3, 16, 18]

Medication	Side-effect profile
Alpha adrenergic agonists	Topical allergy, dry mouth, exacerbation of cardiac disease, headache, sleep or gastrointestinal (GI) disturbance, hypertension, fatigue, interaction with MAO inhibitors, and tricyclic antidepressant agents
Beta-2 adrenergic agonists	Topical allergy, aphakic/pseudophakic macular edema
Beta 1 and 2 antagonists	Hypotension, bradycardia, bronchospasm (less in B-1 selective agents), fatigue/loss of exercise tolerance, exacerbation of underlying cardiac disease, masking of hypoglycemia or thyrotoxicosis, depression, impotence, syncope, headache
Carbonic anhydrase inhibitors	Topical: Local allergy, stinging, oral > topical with metallic taste, GI disturbance, idiopathic aplastic anemia, metabolic acidosis, hypokalemia, paresthesias, anorexia, fatigue, kidney stones, depression, weakness, metabolic acidosis
Osmotic diuretics	Exacerbation of underlying cardiac disease, subarachnoid hemorrhage, rapid diuresis
Parasympathetic cholinergic agents	Miosis causing difficulty with dark adaptation and mesopic conditions, cataract, myopic shift, headache, GI disturbance, diaphoresis, dyspnea, hypotension, arrhythmia, weakness, bronchospasm
Prostaglandin analogues	Topical allergy, iris and eyelid pigmentation, growth of lashes, conjunctival hyperemia, uveitis, macular edema, musculoskeletal pain

glaucoma medication [16]. Alpha agonists, in particular, have been found to cause increased morbidity in the elderly due to their ability to cross the blood-brain barrier and cause sundowning, somnolence, and confusion [16]. The elderly take more systemic drugs with which ophthalmic drugs can interact and have lower serum albumin and other plasma-binding sites, such that there is more competition for binding and more free drugs available. Therefore, elderly patients in particular should be instructed on punctual occlusion and lid closure to minimize systemic adsorption of their topical medication. Oral glaucoma medications pose even greater risk for drug-drug interactions and exacerbation of systemic comorbidities, in particular CNS depression/somnolence and exacerbation of chronic kidney disease. Elderly patients on oral carbonic anhydrase inhibitors could be monitored in partnership with their primary care provider with complete blood count (CBC) and kidney function labs [17].

Because elderly patients with glaucoma frequently have comorbid constitutional diseases such as arthritis, they should be instructed and observed performing the correct instillation of their topical medications. Elderly patients with arthritis in their hands, peripheral neuropathy, or generalized weakness can be asked to demonstrate self-administration of drops with a sample of artificial tears. Although these dropper bottles have different shapes and rigidities, this simple test can give a general confirmation whether the patient is able to self-administer drops.

If there is an observed difficulty with drop instillation, there are a number of options for assisting the patient to better deliver their medication. Difficulty with steady hand positioning can be remedied by purchasing an eye drop guide (a plastic brace that fits around the neck of the bottle and rests on the periorbital skin/orbital rim), many of which are commercially available and inexpensive [19]. Limited neck extension can make placing the eye drop in the inferior fornix difficult. This can be alleviated by having the patient instill their drops lying down (while in bed in the morning and evening is a convenient time for once or twice daily dosed drops) with the neck of the bottle resting on the bridge of the nose and the nozzle over the desired eye. Another benefit of this method is that the patient can close their eyes while administering drops; gravity brings the drop to the medial canthus, the most dependent area of the supine periorbita.

Even with good technique for drop instillation, there remains a large issue with daily compliance [20]. Keeping the bottle near something the patient does every day at the same time (e.g., toothbrush, television remote control) helps with compliance. If the patient takes multiple IOP-lowering drops, it is helpful to provide the patient with a printed grid. The drop name and cap color are written in large letters along one axis and the time to take the drop along the other axis (Table 2). The patient moves the dropper bottle across the grid as they take their drops, visualizing the doses taken and when to take them next. In patients taking more than one eye drop, it can be helpful to mention cap color in addition to medication name, as this is a common way patients identify drops [21].

Elderly patients are also at higher risk for complications after glaucoma surgery including suprachoroidal hemorrhage [23]. As such, a thorough discussion of risks and benefits of any surgical intervention is necessary. It is important to have this discussion with the patient as well as their family or support system given the increased

Table 2 Eye drop medication class by cap color [22]

Medication	Side-effect profile
Adrenergic agonist combinations	Light green
Adrenergic agonists	Purple
Anti-infectives	Tan
Anti-inflammatory, nonsteroidal	Gray
Anti-inflammatory, steroids	Pink
Anti-inflammatory, immunomodulators	Olive green
Beta-blocker combinations	Dark blue
Beta-blocker	Yellow
Beta-blocker (pediatric dose)	Light blue
Carbonic anhydrase inhibitors	Orange
Cytotoxic	Black
Miotics	Dark green
Mydriatics and cycloplegics	Red
Prostaglandin analogues	Teal

assistance that is required after glaucoma surgery. Transportation to frequent postoperative clinic appointments, increased drop usage, and blurred vision perioperatively can have profound quality-of-life consequences, particularly if the surgical eye is the patient's better or only eye. It is to the patient's and physician's benefit to plan for these changes ahead of the surgical date to allow for adequate patient assistance.

Interpersonal and Communication Skills

Good communication skills are essential when interacting with the elderly but in particular the older patient with glaucoma. This includes awareness of and recognition of the unique social, economic, physical, and mental needs of elderly patients with glaucoma. For example, a frank discussion of financial resources available for medication might be needed in an elderly patient on a fixed income. The financial hardship created by an expensive branded medication might be sufficient grounds to select a less expensive or generic alternative. The clinician should consider asking the older patient specifically if they prefer generic medication over brand name therapy. In addition, elderly patients are often already dosing systemic medications throughout the day and may prefer a topical drug with multiple dosing to paying additional money for a slow-release, single-use medication. Although patients may talk freely about this aspect of care when the subject is raised by the practitioner, they may be unwilling to broach the subject themselves.

Family members may be able to provide additional valuable information that impacts compliance. They may accompany an elderly patient to their appointments and can be consulted as to the patient's compliance with medication, side effects from medication, and coexistent medical conditions. Some family communication may be nonverbal, and it may be quite helpful to keep them visible while taking a history from the patient. A family member grimacing and shaking their head may be a more helpful indicator of compliance than the patient's verbal pronouncement and can at least raise the question for discussion with the patient about their ability to independently dose their own medication.

The clinician should strive to put the patient at ease. Allowing the patient to share sometimes difficult personal information can have vast implications on compliance and care. A patient who is unable to recall their care plan or to comply with their medication may be unwilling to state this due to the implications on self-reliance, self-sufficiency, and the need for institutional care. It may be difficult to discover a difficulty with medication, as patients with dementia may retain their interpersonal and communication skills far into their disease. A clinician viewed as hurried or uninterested will also not gain the patient's confidence. The patient and their family read nonverbal cues as well as the clinician. Sitting during the interview instead of standing, maintaining good eye contact, and giving the patient ample time to answer a given question will improve communication with the patient. Asking a patient to list the medication they are taking and the dosing of that medicine may be much more informative than asking them to confirm medicines read from the chart. In this age of declining reimbursements leading to more rapid patient encounters, it is increasingly important to remember the communication competency when dealing with the elderly patient.

Professionalism

Aspects of physician professionalism can affect both the eye care and overall health care of the glaucoma patient. The healthcare provider should recognize and respect the elderly patient's need for independence and show compassion and empathy for the psychosocial aspects of the disease, including fears of blindness and dependency. Although it is important to confirm medical compliance, it is also important to respect patient's autonomy and independence. The clinician in this setting may have to spend more time with the elderly patient with glaucoma to address any social or non-ocular but age-related impediments to care. These adjustments allow the patient to retain dignity through self-reliance, independence, and autonomy but allow the option of adding additional assistance from visiting family members or from home health services.

The professionalism competency also includes ethics and the withholding of medical care. An example of such a choice is seen in the decision to either proceed with surgery or to continue with suboptimal medical management in a poorly controlled, elderly glaucoma patient. Although advanced age and comorbid medical conditions will impact patient care, the decision to treat aggressively or not should be made in discussion with the patient, and if they are not able to make the decision independently, then the discussion should include their family members or other caregivers. The withholding of medical or surgical care based on chronologic age alone is not appropriate and is a form of "ageism." A healthy, spry, independent living 90-year-old may in fact be a better candidate for aggressive treatment than a frail, incapacitated, institutionalized, or terminally ill 70-year-old patient. It is better to outline the benefits and risks of the medical and surgical options, including the effect of advanced age on surgical outcome, and allow the patient to decide on their course of treatment.

Table 3 Top questions to ask your elderly glaucoma patient

1. Do you have asthma, emphysema, or chronic bronchitis?
2. Do you have heart disease, rhythm problems, or heart failure?
3. Do you have hypertension or hypotension? Do you take a beta-blocker?
4. Can you walk up a flight of stairs without stopping for breath?
5. Are you diabetic? Do you get hypoglycemic?
6. Would it bother you if your eyes changed color?
7. Have you ever had inflammation in the eye (uveitis) or macular swelling?
8. Have you had complicated cataract surgery?
9. Are you on antidepressants of any kind?
10. Do you have any allergies to medicines, particularly eye drops? If so, what was the allergy?
11. Are you able to give yourself medication, specifically eye drops?

Practice-Based Learning and Improvement

There is overlap between the practice-based learning and improvement and with the medical knowledge competencies. The clinician should stay abreast of new medical practices and apply these best practices to their own patient care. This would include being facile with the new medicines available for glaucoma and the new surgical options for treating the disease. Most new medications have a limited number of recognized toxicities and contraindications outlined at the time of FDA approval. More of these toxicities become defined with case reports or FDA updates in the months to years after a drug is approved. The clinician should stay abreast of the literature and new drug information and apply this information to the different patient populations with whom they interact (Table 3). In our scenario, this would include recognition of the special pharmacokinetics in the elderly population. Although there may not be specific contraindications in glaucoma drug therapy simply by age, the clinician should be cognizant of the interaction of comorbid disease and medication toxicity frequently encountered in the elderly [24].

Systems-Based Practice

The system of care includes all facilities and individuals that a patient will encounter during the course of their therapy. In this case, the system of care includes the patient, the clinician, the family caregivers, and the skilled home healthcare providers that were refused by the patient. In addition, the local system of care includes the pharmacy where the patient obtains their medication, the primary care practitioner managing their hypertension, and the local hospital and emergency department. The macro system of care includes the pharmaceutical company and industries that make their medication, the insurance agent and company (in this case Medicare and the federal government), any cost-containment policies of these third-party payers, and the health policies of the county, state, and federal government. The clinician should be aware of how their own provision of care is influenced by the other components

of the system of care and how to employ those other components to the best advantage of the patient. The clinician should work within their system to provide the best quality care with the most optimal use of the limited resources of the system.

Case Resolution

In this case, observing the patient self-administer drops and improving his technique and compliance were the most important parts of the encounter. The clinician discussed with the patient and family the failure of proper drop application and the option of home healthcare assistance. The patient was adamant about his ability both to remember and to instill his own medications and declined attempts to arrange home health care. The clinician however brokered an agreement to allow the daughter to assist in her father's care. The daughter lives near to her father and has come to all of his appointments and thus gains her father's consent to witness the daily instillation of drops. The daughter works during the day and so cannot come in late morning, and the patient is "not a morning person," staying up at night and waking after 9:00 AM.

In this case, the clinician changed the medication to a single evening dosing of a prostaglandin analogue. Nighttime dosing of prostaglandins coordinates the schedules of the caregiver and the patient with the optimal dosing for the drug in question. The selection of a prostaglandin lessens the likelihood of postural hypotension in this chronically hypotensive patient, not only decreasing the risk of falls but also lessening the likelihood of inducing nocturnal hypotension and potential side effects such as anterior ischemic optic neuropathy. The solution format of the prostaglandin was preferable in this case as well. Gel-forming solutions can temporarily blur vision and contribute to a fall. Gels are also more difficult to squeeze from a bottle in patients with arthritis or weak finger strength.

Having reviewed the risks and benefits of the new medication and the alternatives to treatment, he is given a written prescription and a follow-up appointment for IOP evaluation in 6 weeks' time. The patient and daughter are instructed to see his primary care physician for evaluation of his dizziness and for a fall prevention assessment.

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