

## Updated Prevalence and Management of Glaucoma in Elderly

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### Abstract

**Background:** Glaucoma is considered a serious disease as it affects more than 70 million people around the world, it is defined as multiple conditions that cause blindness and irreversible visual, glaucoma is the second cause of vision loss worldwide. Aging is the second causing factor of glaucoma after increased intraocular pressure (IOP). Studies showed that the incidence of POAG increases with aging as it increases about five- to tenfold from the 5th to the 8th decades. Management of glaucoma starts once the case is diagnosed, it requires long term control of the IOP over the life to make sure it is not elevated, also monitoring of the visual field and optic disc is also necessary.

**Aim:** In this review, we will look into the prevalence, updated management specific problems of medical treatment of glaucoma in elderly.

**Conclusion:** Glaucoma is one of the serious diseases that can cause blindness if untreated, as it is mostly an asymptomatic disease it requires early diagnosis to avoid serious damage to the optic nerves. The treatment of glaucoma is individualized based on many factors such as the age of the patient. It is necessary to conduct more studies to understand the prevalence of glaucoma there and also the right strategies to improve the conditions of the patients there and ensure good quality of life.

**Keywords:** Glaucoma in Elderly; Geriatric Glaucoma; Prevalence of Glaucoma in Elderly; Updated Management of Glaucoma

### Introduction

Glaucoma is considered a serious disease as it affects more than 70 million person around the world, it is defined as multiple conditions that cause blindness and irreversible visual, glaucoma is the second cause of vision loss worldwide. The number of cases is expected

to reach more than 80 million patients by 2020 [1]. Glaucoma is characterized by chronic optic neuropathy with progressive damage of the optic nerve [2] this disease is mostly asymptomatic and symptoms arise only in late stage when serious problems of vision happen. This all makes early diagnosis and treatment an essential step in management of the disease [3].

As the number of the patients increased over time, World Health Organization (WHO) considered glaucoma as the priority blinding eye disease. And recommended collecting more data about visual impairment and epidemiology of eye diseases mainly glaucoma [4].

And as the number of aging population is increasing, the number of patients with glaucoma is expected to increase too [5]. Glaucoma is asymptomatic at early stages, so studies showed that about half of the glaucoma cases are still undiagnosed and unknown, these studies are carried out by western developed countries [6].

Glaucoma is not only one type, it is divided into many subtypes. The most important and common subtypes are primary open-angle glaucoma (POAG) and primary angle closure glaucoma (PACG), this classification is based on the state of angle of irido-corneal drainage, so if the angle is open it is called primary open-angle glaucoma (POAG) and if it is closed or tight it is called primary angle closure glaucoma (PACG) [7]. All different subtypes of glaucoma share common characteristics and features which are: damage of the optic nerve that causes progressive optic neuropathy and gradual loss of visual field, if it keeps progression without treatment it can cause blindness [8].

Aging is the second causing factor of glaucoma after increased intraocular pressure (IOP). Studies showed that the incidence of POAG increases with aging as it increases about five- to tenfold from the 5<sup>th</sup> to the 8<sup>th</sup> decades [9]. Age is also an important leading factor to the increased number of PACG cases worldwide. Mainly if the age is more than 60 years, the probability of developing glaucoma is expected to be 9.1 [10].

Elevation of intraocular pressure IOP is a risk factor for developing glaucoma, as most cases of different subtypes showed significant increase in IOP. But it should be taken into consideration that not all the elevation in IOP causes glaucomatous optic neuropathy, but it sometimes increases the risk so when the level is very high treatment is necessary to avoid turning to glaucoma [11], also some cases of glaucoma did not show elevation of IOP, we call this case normal tension glaucoma (NTG), which is a variant of POAG, here the IOP is normal, but also lowering IOP is still effective in treating this case [12].

Management of glaucoma starts once the case is diagnosed, it requires long term control of the IOP over the life to make sure it is not elevated, also monitoring of the visual field and optic disc is also necessary. The chronic and asymptomatic types of glaucoma are more common than the acute and symptomatic types. Most forms of glaucoma that are related to age show high severity of symptoms, which shows that glaucoma is affected by age and more common in elderly people with more severe symptoms [13].

Prevention and treatment of glaucoma is a worldwide concern, also for many health organizations especially world health organization WHO, as in its plan for 2020 it showed a big concern to reduce the number and treat as much as possible of the patients, the number had already decreased but this is mainly due to the surgical intervention by having many cataract surgeries, especially in developing countries, not because of pharmacological or medical intervention to treat high IOP, or improve the health care service [14].

In this review, we will look into the prevalence, updated management specific problems of medical treatment of glaucoma in elderly.

### Participants and Methods

**Study design:** Review article.

**Study duration:** Data were collected between 1 June and 30 October 2020.

**Data collection:** Medline and PubMed public database searches have been carried out for papers written all over the world on the most notable advances in childhood sudden death disorder. The keyword search headings included “glaucoma in elderly, geriatric glaucoma, prevalence of glaucoma in elderly, updated management of glaucoma” and a combination of these will be used. For additional supporting data, the sources list of each research was searched. Criteria of inclusion: the papers have been chosen on the basis of the project importance, including one of the following topics: glaucoma in elderly, geriatric glaucoma, prevalence of glaucoma in elderly, updated management of glaucoma. Criteria for exclusion: all other publications that did not have their main purpose in any of these areas or multiple studies and reviews were excluded.

### Statistical analysis

No predictive analytics technology has been used. In order to evaluate the initial results and the methods of conducting the surgical procedure, the group members reviewed the data. The validity and minimization of error were double revised for each member’s results.

### Prevalence

The prevalence of glaucoma is increasing in non-linear pattern with age, it is expected that more cases of glaucoma will happen in the future cause numbers of aged people is increasing, as the technology is expanding the usage of modern technologies, education and digitalizing are important factors in development of glaucoma as many people over 65 years old are using computers and driving cars [15].

In 2010 there were about 60.5 million cases of primary open-angle glaucoma (POAG) and primary angle-closure glaucoma (PACG) between those aged more than 40 years old, this number increased in 2013 to 64.3 million [16]. Also, the number of cases is high and keep increasing, it is expected that most of the cases are still undiagnosed or sub-optimally managed. In developing countries, the data is not enough to give a significant statistics, but the data showed that in 2010, Africa was 4.32% which is highest prevalence of POAG and ACG combined, after Africa comes Latin America (LATAM) with a prevalence of 3.35%, India, China and Southeast Asia had prevalence between 2.38% and 2.66% [16].

The LALES study in the United states of America showed a prevalence of open angle glaucoma Latino descent of 4.74%, this percentage increases to be 22% with elderly people over 80 years old when compared to those aged between 40 and 49 years old [17], the surprising thing about this study was that about three-quarters of those diagnosed with glaucoma were not aware that they had glaucoma. a population based study at 2013 in south Brazil [18], showed that the prevalence was 3.4% in those aged more than 40 years old. Also, a national survey was conducted recently to study the prevalence of glaucoma in Algeria, showed that the percentage is about 4.6%.

Also, the data about the prevalence of glaucoma are not a lot especially in developing countries, the limited available data suggest a pattern of increase glaucoma cases worldwide and especially in developing countries due to many factors, this all make it important and urgency to more studies to understand the scope of expansion of this disease and also to ensure the suitable funding and strategies to improve the health care of the glaucoma cases [19].

### Updated treatment

Although there are many factors that contribute to glaucoma, management focuses mainly on treating the high intraocular pressure IOP, even in cases where the IOP is normal such as NTG. It focuses mainly on reducing the IOP which improves the stability of the patient or at least reduce the incidence of deterioration, unfortunately although the effort made to achieve this, there is a significant number of cases that are subjected to deterioration, this happens mainly due to presence of other factors such as autoimmunity and low cerebrospinal fluid pressure [20,21].

Lowering IOP could achieve conversion from ocular hypertension (OH) to POAG, that could attenuate the deterioration process, for each individual patient the target IOP is determined according to many factors such as the age, the visual field and the severity of optic

nerve damage, based on the previously mentioned data, if the case is young with late glaucoma it will acquire aggressive therapy, but if it is old with early glaucoma then the aggressive therapy should be avoided to maintain a good life quality and prevent the unwanted side effects of the treatment [22].

Although IOP can be reduced by surgery such as laser and incisional surgeries, medical treatment is still the first line for treatment. Medications that reduce the IOP could be used locally or systemically, medications that reduce IOP act by different a mechanism which enables the usage of different medications together to achieve synergistic effect. Side effects happens with both local and systematic medications as local medications can cause, lacrimation, dry eye, irritation, toxic or allergic conjunctivitis and/or keratopathy while the systematic ones could also cause systematic problems such as cardiovascular problems shown with b-blockers [23].

### Medical anti-glaucoma therapy

**Beta-blockers:** b-blockers act by inhibiting b-adrenoceptors on the ciliary body, the first medication of this group was discovered at 1970, timolol; then many other similar of it became available with difference in the characteristics such as Betaxolol which is less effective but more cardio selective, and Carteolol that has almost the same efficacy as timolol but it shows intrinsic sympathomimetic activity (ISA) [24]. The topical preparations of b-blockers requires usage twice daily, but some gels require only once daily usage. The systematic effect of topical b-blockers is more than the oral as the topical preparations are absorbed through the venous circulation where it bypass the hepatic metabolism and enter the circulation with high concentration, affecting mainly the cardiovascular and respiratory systems [25].

The main side effects of b-blockers are bronchospasm, bradycardia and exacerbation of heart failure, so they are contraindicated in those with heart block, bradycardia, asthma and chronic obstructive pulmonary disease [26].

**Prostaglandin analogues:** They are the most potent ocular hypotensive agents, they are available since 1990, such as Topical PGAs (latanoprost, travoprost, bimatoprost, tafluprost and unoprostone), they require administration only once daily due to their high efficacy [27]. They act by improving the aqueous outflow through uveoscleral outflow route, the other advantage of this group beside their high efficacy is their low side effects, as theoretically they can aggravate asthma but practically they do not so they are not contraindicated in asthmatic patients [28]. Also their systemic side effects are low cause their systemic concentrations are very low after topical administration. A study showed that latanopros appeared in the plasma after 5 minutes of topical administration and reached only 53 pg/ml also the elimination half-life of only 17 minutes [29].

Common topical side effects of this group include periocular skin pigmentation, change in iris colour, lengthening and thickening of eyelashes and, more rarely, uveitis or keratitis, it is suggested that bimatoprost is the most efficient member of this group as it acts by 2 mechanisms on both prostaglandin and prostamide receptors. Prostaglandin Analogues are the most expensive group but they are also the most efficient one with low side effects which make it the first line of treatment [30].

**Carbonic anhydrase inhibitors:** They act by two mechanisms as they reduce aqueous secretion by the ciliary body and also have a weak diuretic effect that reduces the IOP. Topical CAIs (dorzolamide, brinzolamide) became available in the mid-1990s [31].

The systemic side effects of this group include headache, dizziness, nausea/vomiting, reduced appetite, diarrhea and allergy. it is contraindicated to use Acetazolamide when the patient has renal impairment, significant hepatic impairment. It also should be used with caution in elderly patients [32].

The structure of acetazolamide was modified to produce topical ones with less side effects, but the made alternatives showed less potency compared to acetazolamide so they require administration many times (three times daily) to achieve the required decrease of the IOP [30].

**Alpha-agonists:** This group has been used for decades for the treatment of glaucoma, but their usage was limited due to their side effects. Members of this group include guanethidine, adrenaline (epinephrine) and dipivefrin, the severe side effects and poor tolerability lead to development of new class called specific  $\alpha_2$ -adrenergic receptor agonists aiming to decrease the unwanted side effects [32].

Brimonidine, a member of this new class became available in the markets in the mid-1990s, also it is used widely it still show unwanted side effects especially in those aged more than 60 years old. it is administered twice daily. Apraclonidine, another agonist it is used more in short term treatment due to causing allergy when used on long term [33].

By reducing aqueous development,  $\alpha$ -agonists primarily act to decrease IOP, but also increase outflow through the trabecular meshwork and likely through the uveoscleral outflow pathway [34].

The common ocular side effects of this group include significant hyperaemia, degree of mydriasis and frank allergy, while the systematic side effects include dry mouth, taste perversion, lethargy, drowsiness, depression, hypotension, and palpitations [35].

**Miotics:** They were first used 120 years ago, also they are not used much nowadays, pilocarpine is still used in management of some cases especially angle closure and plateau iris [36]. Miotics boost the outflow facility by expanding the drainage channels by inducing ciliary muscle contraction within the trabecular meshwork [37].

Pilocarpine requires four-fold daily administration and has many side effects including (miosis, blurred vision secondary to induced myopia, ciliary spasm-associated brow pain, cataract) Pharmacodynamics Sciences of Pilocarpine was not thoroughly elucidated, but sweating, bradycardia and gastrointestinal discomfort are possible systemic side effects from topical miotics [38].

**Combination therapies:** In combination with a b-blocker (latanoprost/timolol, travoprost/timolol, bimatoprost/timolol), some of the topical PGAs are available, as are the CAIs (dorzolamide/timolol, brinzolamide/timolol). An agonist/b-blocker of a combination therapy (brimonidine/timolol) is available, as is a b-blocker miotic (pilocarpine/timolol) combination. Recently, a CAI combination with an  $\alpha$ -agonist (brinzolamide/brimonidine) has become available and is the only one available.

Combination therapy that does not include a b-blocker is currently available. For patients who have to use one rather than two bottles of antiglaucoma treatment, the possible and apparent benefits of fixed combination therapies are strong.

The potential for enhanced adherence, reduced exposure to drop preservatives, reduced washout effects with multiple therapies, and potential cost savings are known [39].

### Specific problems with medical anti-glaucoma therapy for elderly patients

#### Side effects

Systemic adverse effects of anti-glaucomatous treatment are also more likely to be of clinical concern in elderly patients with inherently greater vulnerability and likelihood of serious consequences. Due to the age associated with Comorbidity disorders are more prevalent in the elderly population because of the complexities of certain medical conditions. In particular, the age-related coexistence of glaucoma with cardiovascular or respiratory system disorders also prevents topical b-blockers (and therefore the majority of topical b-blockers) from being used for IOP management [40].

#### Drug interactions

Elderly users are more likely to take more systemic medications than their younger patients thereby making them more vulnerable to adverse drug interactions. The risk that b blockers could have harmful interactions Until administering them improperly, and other medi-

cations should be considered the effect of any medication prescribed to reduce heart rate may be compounded by topical b-blockers and may precipitate cardiac arrhythmia or also cardiac arrest or bradycardia [41]. When evaluating possible interactions between b-blockers and calcium channel blockers (e.g. verapamil or diltiazem), cardiac glycosides (e.g. digoxin) and cardiac glycosides (e.g. digoxin), special caution should be used.

### Sodium blockers (e.g. lidocaine or procainamide) or sodium channel blockers

A common age-related disorder is diabetes and it should be noted that b-blockers can mask the symptoms of hypoglycemia in diabetics who take hypoglycemic drugs [42].

### Long term tachyphylaxis

The older a patient, the more likely they are to be treated for glaucoma for longer periods than younger patients, but this does not, of course, extend to those patients whose glaucoma has been diagnosed late in life. For the ideal care of patients that have been subjected to long-term anti-glaucoma medication, there are a variety of issues that could be applied. Tachyphylaxis (reduction in drug response) is an issue especially with b-blockers, that necessities stop usage of the ineffective drug and the usage of another effective one [43].

### Conclusion

Glaucoma is one of the serious diseases that can cause blindness if untreated, as it is mostly an asymptomatic disease it requires early diagnosis to avoid serious damage to the optic nerves. The causes of this disease are many but the most important one is the high intraocular pressure IOP, so most of the management techniques and medications aim to decrease the IOP. The treatment of glaucoma is individualized based on many factors such as the age of the patient. The economic factor and life expectancy, developing countries are the most affected places worldwide, although the data available about the prevalence of the disease within these countries is few, but it still indicates that the prevalence is high. It is necessary to conduct more studies to understand the prevalence of glaucoma there and also the right strategies to improve the conditions of the patients there and ensure good quality of life.

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