

Understanding “The Silent Thief of Sight”: a Review of the Causes, Diagnosis, Management and Impact of Glaucoma on Quality of Life

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Received 11 March 2024; Accepted 25 April 2024; Published 13 May 2024

ABSTRACT: Glaucoma is a chronic disease of the optic nerve leading to irreversible blindness. Globally it is the second leading cause of blindness after cataract. Because of the insidious onset and presentation, most sufferers are unaware of loss of vision until it creeps on the patient like a thief hence, glaucoma is referred to as the “silent thief of sight”. Glaucoma is a major public health concern, with an estimated 76 million sufferers worldwide in 2020, projected to increase to 111.8 million by 2040. It is most prevalent among the Black and Asian populations, presenting earlier in Africans compared to Caucasians. The pathogenesis and risk factors for glaucoma vary depending on the type, with Primary Open-Angle Glaucoma and Angle Closure Glaucoma being the most common. Both types are characterized by raised intraocular pressure, which can significantly impact quality of life. The primary goal of glaucoma management is to prevent further degeneration of the optic nerve, preserve vision, and improve overall quality of life. However, there is a high level of unawareness and knowledge about the condition, leading to late presentation and poor adherence to treatment regimens, ultimately resulting in profound vision loss and irreversible blindness. It is crucial to raise awareness and improve access to early detection and treatment in order to mitigate the impact of this widespread condition. The winning card for the battle against “the silent thief of sight” is early detection, effective management and collaboration among all health professionals in creating more awareness and knowledge on glaucoma, promoting scientific researches for novel discoveries to mitigate degeneration and promote restoration of damaged optic nerve.

Keywords: Glaucoma, Causes, Diagnosis, Management, Impact, Quality of life.

Citation: Odigie, I. C. (2024). Understanding “The Silent Thief of Sight”: a Review of the Causes, Diagnosis, Management and Impact of Glaucoma on Quality of Life. *Direct Res. J. Public Health and Environ. Technol.* Vol. 9(2), Pp. 104-115., <https://doi.org/10.26765/DRJPHE705426118>. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Glaucoma is a chronic progressive disorder of the optic nerve that result in irreversible blindness. It is characterized by a progressive degeneration of the optic nerve, with loss of retinal ganglion cells, thinning of the retinal nerve fibre layer and “cupping” of the optic disc. It is invariably associated with increase in intraocular pressure. Glaucoma is the leading cause of irreversible blindness with an estimated population of people worldwide affected by primary open glaucoma at 57.5 million and by 2020 it was estimated that approximately 76 million people would suffer from glaucoma increasing to 111.8 million by 2040 (Liu et al., 2023). Glaucoma poses a great degree of public health concern as it is the second leading cause of blindness after cataracts (Allison

et al., 2020). Studies on epidemiology of glaucoma in Africa and Nigeria revealed that 1.1 – 1.4 million Nigerian adults have glaucoma with an overwhelming number of them not aware of their disease status. In other words, one in every twenty Nigerian adult past the age of 40 years have glaucoma and one in five of the above figures are blind, adding that blindness due to glaucoma can be avoided if the glaucoma is detected early, promptly and effectively managed (Kyari et al., 2015). Glaucoma presents early in onset in Africans and progress more aggressively in its course, leading to blindness earlier in Africans than Caucasians. In addition, only one in twenty of those diagnosed with the disease are aware with over 50% being unilaterally blind on presentation (Kizor-

Akaraiwe, 2021). Wolvaardt and Hu (2021) stated that in most surveys carried out in high income countries, over 50% of people who have glaucoma are under diagnosed, while in low/ and or middle-income countries the number increased to 90% and as many as 35% of people diagnosed with glaucoma present with severe visual impairment. There is a very important need to create more awareness of glaucoma to reduce the negative impact of glaucoma on the quality of life of sufferers and mitigate against preventable blindness. During a Sight-savers supported project (Keep Sight) in Nigeria to train eye surgeons on new methods to treat people with glaucoma, the team leader, Prof Ayanniyi asserted that “It is possible for somebody or an individual with glaucoma to have near normal vision throughout their life” (Sightsavers, 2021).

Aim

To raise awareness on glaucoma and the measures to mitigate its effect on visual health and overall quality of life

Specific objectives

1. To raise awareness about the silent nature and course of glaucoma as an unseen threat to vision.
2. To provide insight into the diagnostic approaches by offering a comprehensive understanding of their significance in early detection.
3. To discuss effective management strategies, emerging therapies, and also unveil the impact of glaucoma on quality of life.

What is Glaucoma?

Awareness and knowledge of glaucoma

Figure 1: Interior segment of the eye showing structures affected by increase intraocular pressure. Source: Glaucoma Research Foundation (2021). Glaucoma is defined as an eye disease characterized by progressive optic nerve atrophy and loss of vision (Figure 1). It is not one disease but rather a group of disorders characterized by increased intraocular pressure and the consequences of elevated pressure, optic nerve atrophy and peripheral vision loss (Basavanthappa, 2009). These group of disorders are characterized by their different pathophysiology, risk factors, clinical features and treatments but are all associated with a common feature which is progressive degeneration of the optic nerve and excavation or cupping of the optic disc.

Etiology/causes

Experts do not exactly know what because glaucoma but

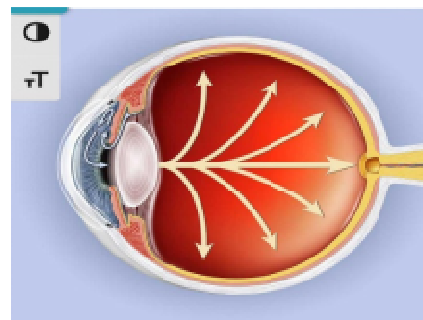


Figure 1: Interior segment of the eye showing structures affected by increase intraocular pressure.

Source: Glaucoma Research Foundation blog.

there are associated risk factors which include the following:

- Older age (from 40 years and above)
- Family history of glaucoma
- Increased intraocular pressure
- Race/Ethnicity
- Use of systemic or topical corticosteroids
- Refractive error
- Diabetes mellitus
- Hypertension/Systemic Hypotension
- Migraine

Age

Although age is an established important factor for glaucoma, it is good to recognize that there are congenital types of glaucoma (Infant, Juvenile and Childhood glaucoma). One of the reasons age is considered a risk factor is that as we get older, the lens also gets thicker and the increase in the thickness of the lens can further narrow angles that are susceptible to being narrow. In addition, aging likely contributes to the vulnerability of the optic nerve such that the aged optic nerve is less able to withstand various affronts such as elevated intraocular pressure and reduced facility of aqueous outflow. The American Academy of Ophthalmology recommends that adults with no signs or risk factors of eye disease should have a baseline comprehensive eye examination at the age of 40. The National Eye Institute recommends that African Americans over age 40, everyone over age 60, especially Mexican Americans and people with a family history of glaucoma should have a comprehensive eye exam and should be examined subsequently every few years because glaucoma can manifest with age (Ou, 2021).

Refractive error

Glaucoma is observed to be more common in myopes.

Myopia has been described as a risk factor for glaucoma in various studies due to the high correlation between axial length and refractive errors. According to these studies, long axial length is a risk factor for open-angle glaucoma, while individuals with short axial length are prone to angle closure glaucoma (Hashemi et al., 2019).

Family history of glaucoma

A positive family history of glaucoma especially if first degree relatives such as parents or siblings have glaucoma. Numerous population-based studies have reported family history as one of the greatest risk factors for glaucoma. Genetic studies have demonstrated that more than 50% of glaucoma is familial, stating further that the rate of glaucoma can be ten (10) times higher among individuals with a sibling who has glaucoma (Okeke, 2022).

Race/ethnicity

There is some evidence that glaucoma has an earlier age of onset in blacks and has a more aggressive clinical course (Kizor Akaraiwe, 2021). Allison et al. (2020) citing Kelly et al (2020) explained that among people aged 40 years and above, 2.2% of Whites have glaucoma compared to 5.7% of Blacks. "The pattern of higher prevalence of glaucoma is reported in West Africa than South Africa, which in turn is higher than the prevalence in East Africa. Further, the prevalence of glaucoma is higher in Nigeria than in Brazil, Iran, Indigenous populations in Australia, and Qatar".

Use of systemic or topical corticosteroids

Steroids or Corticosteroids are autoimmune and anti-inflammatory drugs and are commonly prescribed to treat medical conditions including allergic, autoimmune and inflammatory conditions. Unsupervised steroid usage can cause many adverse effects on the eye, the most important being steroid-induced glaucoma and cause permanent optic nerve damage. The term "steroid responder" (SR) is used to refer to individuals that show elevated intraocular pressure after steroid use. Phulke et al., (2017), explained the routes of administration leading to steroid-induced glaucoma to include; topical therapy, periocular therapy, intravitreal therapy, systemic therapy, and other routes such as inhaled corticosteroids stating further that the pressure-inducing potency of steroids is related to the dosage used (0.01% of betamethasone in high topical steroid responders caused significantly less pressure elevation than with 0.1%). 90% of patients with open angle glaucoma develop a steroid response and it is estimated that every week of steroid use averaged over a lifetime leads to a 4% increased risk of chronic steroid glaucoma.

Adding that steroids are now available in over-the-counter preparations such as eye/ear drops, pills, inhalers, skin creams, and joint injections (Pickering, 2022).

Ezinne et al (2021) reported in a study on the prevalence and clinical profile of glaucoma patients in rural Nigeria – A hospital-based retrospective study of glaucoma patients, that out of 5482 case files that were reviewed, 995 (18.15%, 95 CI 17.15 – 19.19%) had glaucoma particularly primary open angle glaucoma. Descriptive statistics were used to analyze the result which revealed that the mean intraocular pressure (IOP) ranged from 15-50 mmHg but higher in females than males. The study concluded that the high prevalence of glaucoma in older people remains a public health problem in Nigeria and it suggested on a need for public health messages to emphasize on early glaucoma screening, detection and management. Sarimiye et al. (2022) reported in a cross-sectional survey on assessment of glaucoma awareness, uptake and satisfaction with a free, targeted glaucoma screening program southwest in Nigeria during the World Glaucoma week activities of year 2021 that out of a total of 94 participants, 58 (61.75%) have heard of glaucoma before the 2021 WGW awareness programs and 75.9% (44) gained some new knowledge from the program. Newly diagnosed glaucoma was 9.6% (n = 9) of which 7 (77.8%) had advanced glaucoma (CDR = 0.9) in at least one eye. Fasoranti et al. (2023) stated that out of a total of 366 respondents were above half (51%) had tertiary level of education, 64.8% had awareness and 49.7% had good knowledge. The result stresses the need to enhance awareness and knowledge through public oriented glaucoma education.

Types of glaucoma

There are two major types of glaucoma; primary and secondary glaucoma. They are further categorized into two major subtypes (open-angle and angle closure glaucoma) and are all categorized by a progressive optic neuropathy (Figures 2, 3 and 4). Primary glaucoma results from open-angle and closed-angle of the drainage system (angle of anterior chamber) while secondary glaucoma results from increased intraocular pressure (IOP) which leads to optic nerve atrophy (Allison et al., 2020).

- I. Open-angle glaucoma comprises of primary open-angle glaucoma (POAG), Normal tension glaucoma (NTG) and secondary open-angle glaucoma. With POAG, there is increase IOP with progressive optic nerve atrophy while NTG is characterized by normal IOP with progressive optic nerve atrophy. Secondary open-angle glaucoma is associated with increased IOP and/or progressive optic atrophy.
- II. Angle closure glaucoma can be grouped into primary angle-closure glaucoma (PACG).

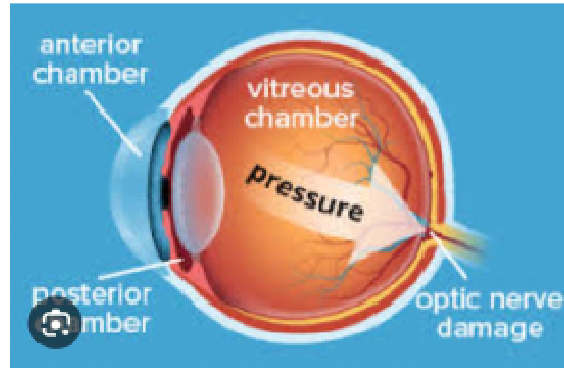


Figure 2: Elevated Intraocular Pressure (IOP):
Source: <https://images.app.goo.gl/ftngTGHK4sSVLTCd9>



Figure 3: A baby with enlarged eyes (Bulphthalmos), enlarged hazy corneas, and excessive watering in both eyes. Source: Community Eye J. Vol. 36 No. 121 2023 pg. 10-12.

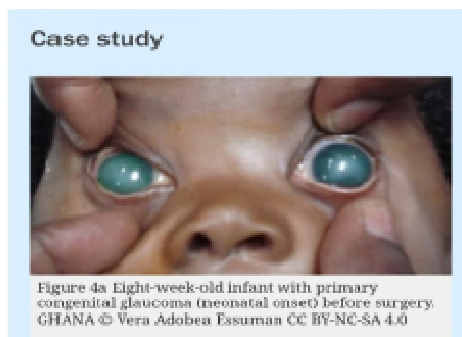


Figure 4a and b: The same child two years after surgery with controlled disease.
Source: Community Eye J. Vol. 36 No. 121 2023 pg. 10-12

Primary open-angle glaucoma (POAG) can also be classified based on the age of onset as:

- i. Congenital glaucoma (from onset at birth up to 3 years of age)
- ii. Juvenile open-angle glaucoma (JOAG) (onset at 3 – 35 years)
- iii. Adult onset POAG (from 35 years and above)

Another classification of PAOG is glaucoma suspect which is characterized by increased intraocular pressure with no structural difference in the optic nerve head.

This is termed Ocular hypertension. Most glaucoma suspects have no symptoms and are usually detected when individuals present themselves to the hospital for other eye complications.

Warning signals of glaucoma

Congenital Glaucoma

- Excessive tearing
- Large eyes (Bulphthalmos)



Figure 5: Level of vision in different stages of glaucoma
 Source: Plano.com/can-glaucoma-be-cured/
 Source: (Blieden and Feldman, 2022)

- Cloudy corneas
 - Photophobia (sensitivity to light)
 - Habitual rubbing of the eyes
- Juvenile Glaucoma
- Photophobia
 - Delayed dark adaptation
 - Head or eye pain
 - Excessive blinking or squeezing of the eye and spasm of the eyelid
 - Consistently red eyes

Adult Glaucoma

POAG – Primary Open Glaucoma

- Blind spots in your side or peripheral vision
- Tunnel vision
- Central vision loss

PACG – Primary Angle-Closure Glaucoma

- Seeing halos around lights (rainbow-colored circles)
- Hazy or blurred vision
- Nausea and/or vomiting
- Severe eye pain and headache
- Sudden loss of vision

(Li, 2022), (Figure 5).

Diagnostic approaches (catching the thief early)

The only sure way to diagnose glaucoma is to undergo a complete eye examination as screening for intraocular pressure alone does not suffice for making a definitive diagnosis for glaucoma. For accuracy and safety in making a glaucoma diagnosis, a complete eye

examination that considers the following five methods should be done:

1. Ophthalmoscopy – to check the fundus of the eye especially the optic nerve head (Figure 6).
2. Tonometry – to ascertain the inner eye pressure / intraocular pressure. The normal eye pressure (IOP) is between 10 -21mmHg
3. Perimetry (Visual fields test) – to assess the peripheral and central field of vision
4. Gonioscopy – to examine the angle of anterior chamber or drainage angle of the eye
5. Pachymetry – to assess the thickness of the cornea

Ophthalmoscopy

Advances in diagnostics

Optical Coherence Tomography (OCT) and Optical Coherence Angiography (OCT-A)

Triolo and Rabiolo (2020) reported in a review on the clinical use of OCT and OCT-A in glaucoma for detection and monitoring as an asset of modern glaucoma clinics may provide useful information in normal-tension glaucoma patients and patients with advanced disease. Concluding, the author stated that various OCT measures may allow a better disease evaluation and overcome the limitations of individual parameters.

24 Hour IOP Monitoring

A number of methods and devices are available for the

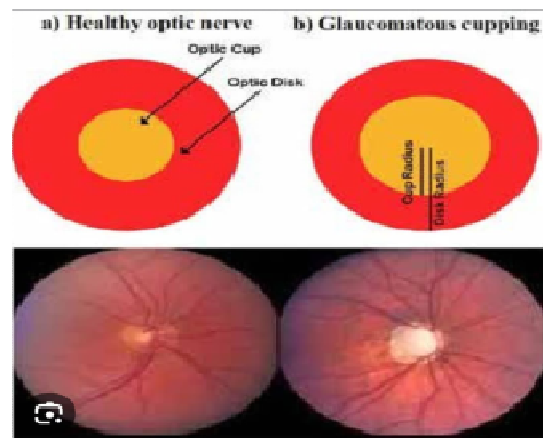


Figure 6: Normal optic disc (a) vs glaucomatous cupping (b)
Source: Glaucoma Research Foundation (2021) <http://www.glaucoma.org/>

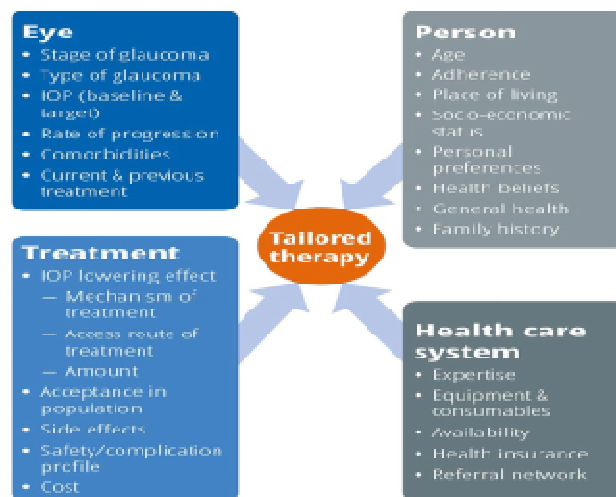


Figure 7: Four key groups of factors determining the individual tailored treatment of glaucoma.
Source: Community Eye Health J. vol. 34 No 112 2021 pg 43.

24-hour IOP monitoring which allow home monitoring of IOP without affecting patients' daily routine or sleep. "Triggerfish" device is one of such contact lens sensor devices and is a proven device of choice in measuring IOP in different glaucoma subtypes. With future research, Triggerfish can become valuable in understanding the progression of vision loss despite attaining target IOP level in some group of patients (Bhartiya et al., 2019).

Heidelberg Retinal Tomograph (HRT)

HRT technique uses laser beam to produce 3D of the optic nerve head for diagnosis, management and tracking the progression of glaucoma (area of the optic disc, the volume of the cup and the area of the rim around the cup).

Nerve fibre analysis (GDx)

GDx uses laser light to measure the thickness of the nerve fibre layer.

Genetics and novel biomarkers in diagnosis

Biomarkers are molecules that indicate normal or abnormal process taking place in the body and may be a sign of an underlying condition or disease. According to several studies have identified classical biomarkers for POAG, revealing some biochemical, molecular and genetic biomarkers to be considered for diagnosis, management and assessment of therapeutic effects of POAG. These biomarkers offer appropriate guidance for early detection and prediction of therapeutic response in glaucoma patients (Pinazo-Duran et al, 2023).

Management strategies/treatment goals

The main aim of glaucoma management is to reduce IOP which is the only known modifiable risk factor as at today. The specific objective is slow or stop the progression of optic neuropathy and maintain or promote overall quality of life for the glaucoma patient (Figure 7). This process involves setting a targeted IOP that should be individualized and constantly reevaluated using medications, laser and surgical options. Lowering the baseline IOP by ≥ 25 percent reduces the rate of progression glaucoma in most but not all glaucoma patients. This necessitates more frequent monitoring to guide the management of glaucoma (Heiko, 2022).

Pharmacological management

This involves the use of topical agents (eye drops). The following are classes of topical medications:

- Prostaglandin analogues (PGAs) e.g. Latanoprost, Travoprost, Brimatoprost etc.
- Beta blockers e.g. Timolol
- Alpha-adrenergic agonists e.g. Brimonidine
- Carbonic anhydrase inhibitors (CAIs) e.g. Acetazolamide (Diamox)
- Parasympatomimetic agent e.g. Pilocarpine

Their action includes reduction of production of aqueous humor, increasing outflow or having both effects. It is important to note that the efficacy (qualitative and quantitative properties) in terms of active ingredient of generic drugs is different than branded drugs leading to efficacy and safety concerns.

In case of disease progression, target IOP level and treatment option should be adjusted to prevent or reduce rate of progression.

Treatment method

A retrospective survey on trends in glaucoma procedures and surgeries at the Eye Foundation hospital group, Nigeria, the following authors Bogunjoko et al. (2019) reviewed the trends on glaucoma procedural treatments from January 2009 to December 2017. They reported that Trabeculectomy had been decreasing in frequency from 117 to 65 (44%), the frequency of use of glaucoma drainage device (GDD) has been increasing from 1 in 2013 to 26 in 2017. The frequency of cataract extraction with Trabeculectomy reduced drastically from 20 in 2009 to 3 (566%) in 2014. Among the laser procedures, transscleral cyclophotocoagulation (g-probe) is commonly done. It increased from 40 procedures in 2009 to 98 in 2014 (145%). There was an increase in laser trabeculoplasty from 15 in 2009 to 44 in 2013 (143%).

Laser iridotomy increased from 12 in 2009 to 26 in 2015 (116%) from 2009 to 2015 there was an increase in glaucoma procedures and surgeries – 206 to 325 (58%) but declined by 27% from 2015 to 2017. In conclusion the authors reported that the rate of trabeculectomy is on the decrease while rate of glaucoma drainage devices GDD and laser procedures are on the increase.

Medication adherence: pivotal to success rate of medical management

According to the Cambridge Dictionary, adherence is the fact of someone behaving exactly according to rules, beliefs, etc. The United States Food and Drug Administration (FDA) states that, "Medication adherence or taking medications correctly is defined as the extent to which patients take medication as prescribed by their doctors. This involves factors such as getting prescriptions filled, remembering to take medication on time and understanding the directions". The American Medical Association says, "A patient is considered adherent if they take 80% of their prescribed medicine(s). If patients take less than 80% of their prescribed medication(s), they are considered non-adherent" (Ross, 2019).

Adherence/Uptake of Follow-Up Care

Kizor-Akaraiwe (2021) in a cross-sectional survey of newly diagnosed glaucoma patients during free eye screening carried out in Enugu, Nigeria, to determine follow up and adherence to glaucoma care by newly diagnosed glaucoma patients, of the 182 newly diagnosed uptake of follow-up care was 17.6% (32/182), adherence rate was 25% (8/32). The major reasons deduced for non-uptake were lack of funds 54.9% (n = 50/91), distance 11% (n = 10/91) and receiving care from other facilities 11.6% (n = 10/91). Others include discourteous staff behaviour and lack of information on diagnosis. Similarly, major reasons for non-adherence were lack of funds 44.4% (n = 8/18) and distance 22.2% (n = 4/18). Knowledge and prior awareness were found to be significantly associated with uptake of follow up care (p = 0.020).

Surgical and laser treatments

Surgery may be recommended for glaucoma in cases where pharmacological therapy or laser therapy have not been effective. The different types of glaucoma surgery are aimed at improving the outflow of aqueous humour or reducing the amount of aqueous produced and also help lower intraocular pressure. Surgery is considered if the medications result in severe side effects such as hypertension, tachycardia or impotence. There are two major types of surgery – laser surgery and traditional/

conventional or incisional surgeries. The different types of glaucoma laser surgery include:

- Laser trabeculoplasty
- Laser peripheral iridotomy (LPI)
- Cyclophotocoagulation (CPC).

Types of Incisional Surgery

Trabeculectomy: this has been proven to be a time-tested treatment for more dangerous glaucoma for over 40 years. Success rate varies from 70-90% in controlling IOP but also carries the risk of post-operative complications some of which might result in vision loss. Others include; Drainage implant, Electrocautery and Minimally Invasive Glaucoma Surgeries (MIGS). Dyrda et al., (2020) reported “Bleb dysethesia is an uncommon complication of glaucoma filtration surgery in which a well-functioning but large filtration bleb with adequate IOP control causes ocular discomfort due to the effect of interrupted tear film distribution over the bleb and cornea.

Microinvasive Glaucoma Surgery (MIGS): Current trends in surgical approach to glaucoma involves the use of MIGS to achieve target IOP and there is growing evidence to support the efficacy as a primary surgical procedure in patients requiring additional IOP control (Triolo, et al. 2020). MIGS are generally faster and safer and also have added advantage of being able to be carried out at the same time as cataract surgery. The safety profile of these procedures is higher than trabeculectomy but less likely to achieve the lower rates of IOP as with trabeculectomy especially in early or mid-stage glaucoma patients who do not benefit from traditional medication therapies.

Other methods that are being developed in understanding better aqueous humor outflow revolves around imaging techniques like structural imaging, canalography, channelography, haemoglobin video imaging, episcleral venous fluid wave and aqueous angiography. These methods are still being studied but it is envisioned that with better aqueous humour outflow imaging, and improved MIGS techniques may also lead to discovery of improved pharmacological glaucoma treatment.

Teleglaucoma/Teleophthalmology: Teleglaucoma as a novel technology for improving glaucoma diagnosis and management in both developed and especially in the developing countries became much impactful during the covid-19 pandemic which required social distancing measures. This important technology provides numerous benefits including expanded access to highly qualified ophthalmologists and other eye care professionals, high quality medical consultations and management and

overall improved disease outcomes.

Host, Turner and Muir (2018) stated that two commonly employed telemedicine models are “real-time” and “store-and-forward”. The real-time model operates by allowing health care professionals and patients direct interaction via audio or audio-visual communications. The store-and-forward model utilizes diagnostic workup data from remote ophthalmic testing center that are sent electronically to health care professionals elsewhere for expert interpretation of shared data.

Impact of glaucoma on vision and quality of life

Vision impairment and progression in glaucoma

“Mr. O.N, a 42-year-old trader, visited the Friday clinic for presbyopias. He was also found to have moderately advanced glaucoma. He had normal vision but his eye pressures were 36/39 mmHg in right/left eye respectively. He was offered surgery but refused because his wedding was only 4 weeks away. He was commenced on medical treatment. Mr. O.N did not return for follow up until seven years later, led by his younger brother. His wife had left him with their two children for economic reasons. He broke down in tears. Mr. O. N's brother was examined and he had early/moderate glaucoma. He was asked to invite his whole family for screening. This is a common manifestation of glaucoma in Africa”. “Culled from glaucoma blindness in Africa” (Kizor-Akaraiwe, 2021). The above scenario is a classical pattern of the impact of glaucoma on vision and quality of life. . Impact of glaucoma on an individual client's quality of life can be described in various aspects of life such as:

Vision related quality of life (VRGoL)

Economic related quality of life (ERQoL)

Psycho-social related quality of life (PRQoL)

Vision related quality of life: relates to how glaucoma affects activities of daily living (ADL). Patients/clients report reduced peripheral visual field (VF) and visual activity (VA) which sometimes result in bumping into objects, risk of falls, inability to drive/walk safely on the street. In the advanced stages of glaucoma, there may be experiences of difficulty in recognizing faces.

Economic related quality of life: results from financial burden of drug/surgical treatment expenditure, clinic appointments, diagnostic investigations and managing side effects.

Psycho-social related quality of life: influences the emotional and social relationships of glaucoma patients. Some may use positive adaptation strategies while others may cope negatively resulting in anger, frustration, depression and social withdrawal.

Glaucoma has a significant depression prediction rate of 10% after adjustment for demographic factors and multiple comorbidities (Allison et al., 2020).

Conner (2023) noted that “estimated number of people with glaucoma worldwide is expected to rise from 76 million in 2020 to 111 million in 2040, with Africa and Asia being affected more heavily than the rest of the world”. Furthermore, Conner cited a study conducted in a rural population in North-Eastern Ghana which revealed bilateral blindness in 34% and unilateral blindness in half of patients receiving an initial glaucoma diagnosis found to be in line with several other studies in sub-Saharan Africa.

In a study conducted and reported by Guchi et al. (2023) a cross-sectional study design was conducted on 319 adult population with glaucoma in Ethiopia using systematic random sampling and a p-value of < 0.05 at a statistically significant level of 95% confidence level. The mean glaucoma quality of life -15 score was 47.85 ± 15.41 . Participants with below primary education, primary education, visual acuity of the better eye and worst eye and severe glaucoma were significantly associated with the glaucoma quality of life -15 score. The result reveal that the vision related quality of life was significantly associated with educational status. The authors recommended educating the glaucoma population on the nature of the disease, advice on early presentation and better coping strategies for the condition.

Blanke et al. (2023) using a prospective randomized monocentric controlled study of 77 patients with primary open glaucoma, evaluated the effectiveness of improvement of glaucoma associated quality of life and adherence in patients reported significant difference in the patient's glaucoma-associated quality of life between the intervention group (rate of improvement: 0.17%, $P = 0.047$) and control group (rate of improvement: 0.17%, $P = 0.047$). Also, a significant difference in adherence between the intervention group, showing 99.8% rate of improvement ($P = 0.002$), and the control group, showing a 3.8% rate of improvement ($P = 0.002$). In conclusion, enabling patients to individual health related glaucoma data by using a digital health application and supporting them with information on the disease led to an improvement in glaucoma associated quality of life and adherence.

Research and innovation frontiers: a future free of blindness from glaucoma?

Numerous ongoing scientific researches to help diagnose, effectively treat and possibly cure glaucoma and restore vision are being undertaken by governmental and non-governmental Foundations. The following provides an overview of what are on the horizon; Novel IOP Lowering Medications for the Treatment of Glaucoma:

- a. Rho-Kinase Inhibitor Netarsudil.
- b. Nitric Oxide – Donating Prostaglandin Analogue:

Latanoprostene Bunod (Vyzulta)

- c. Fixed Combination: Rho-Kinase / Latanoprost
- New Targets for Lowering IOP:
 - a. Cannabinoids
 - b. Melatonin
 - c. Connective tissue growth factor

New drop-free or dropless technologies: there is extensive research and development on “drop-free” or “drop-less” technologies. These devices would deliver the same medications to your eyes to lower eye pressure and treat glaucoma without having to use drops, or with fewer drops. Reducing glaucoma drops on the eye surface may have the added benefit of reducing symptoms of eye irritation and dryness.

Non IOP dependent treatment strategies

Neuroprotection: Oxidative stress and mitochondrial dysfunction interventions that target elevated oxidative stress and mitochondrial dysfunction may prove beneficial to neuroprotective treatment e.g. Ginkgo biloba as oral supplementation. In patients with normal tension glaucoma, Ginkgo biloba slowed progression of visual field damage (Ahmed et al., 2015).

Stem cell therapy: has potential for glaucoma treatment as there are promising results from clinical trials on animal models for Neuroregeneration but further evaluations in more clinical studies are advised. (Hu et al. 2021)

Gene therapy: Gene therapy strategies are based on enhancing survival and regeneration of retinal ganglion cells. This approach is still in preclinical phase for treatment of glaucoma (Hu et al., 2021).

Glial cell modulation: The glial cells are immune-competent cells with the functions of removing dead cells resulting from apoptosis, forms blood-retina barrier, connect neurons to blood vessels and maintains homeostasis by removing ions and neurotransmitters. One of the components of glial cells produce ciliary neurotrophic growth factor (CNTF). The CNTF is in its ongoing phase 2 trial and is being evaluated as a promising target for its neuroprotective effect (Hu et al. 2021).

Pattern-evoked electroretinography (PERG): detects decreased retinal ganglion cell function years before structural loss in glaucoma suspects, and is more

sensitive than OCT for detecting degeneration in affected cells. PERG also significantly predict visual field loss, disease progression and monitor treatment efficacy. (Charters, 2021).

Artificial Intelligence (AI): Available AI platforms provided by Eyenuk Inc Company include – (a) Eye Screen – a human plus AI diagnostic tool used with human graders to review images while AI performs a background check and flags potential errors. (b) EyeArt – provides eye screening at the point of care without requiring a specialist. (c)-EyeMark -a “superpower” AI that can perform an analysis to detect abnormalities and longitudinal monitoring for quantifying and creating biomarkers that human experts cannot produce is undergoing development (Charters, 2021).

Collaborative efforts for prevention and improved management

Collaborative and multidisciplinary care approach promotes the effective management and prevention of progression of glaucoma to prevent avoidable blindness and poor quality of life in glaucoma patients. This necessitates the collaborative building and training among all eye health care professionals. In order to improve the quality of ophthalmic training in developing countries, some renowned ophthalmology institutions in developed and some developing countries such as Moorefield Eye Hospital in United Kingdom, Avarind Eye Hospital in India, among others and also non-profit organizations such as Orbis International via its flying Eye hospital, ,Orbis’s teleophthalmology, and Glaucoma Research Foundation have developed standardized training curricula and expanded use of stimulation in training and online education platforms and ongoing innovative researches.

Lifestyle choices and impact on glaucoma

Numerous scientific studies have provided evidence that making lifestyle changes can have a significant and positive impact on an individual's overall health. These choices have been shown to be effective in preventing and managing various health conditions, including cardiovascular disease, hypertension, and cancer. In the case of glaucoma, recent research is exploring how lifestyle factors can play a role in either preventing the onset of the condition or slowing its progression (Glaucoma Research Foundation, May 14, 2021). However, further objective research is needed in this area, as many existing studies rely on subjective self-reporting. Current knowledge suggests that making adjustments to one's diet, sleep patterns, exercise routine, resilience training, and avoiding smoking may have a beneficial effect on glaucoma.

Official Publication of Direct Research Journal of Public Health and Environmental Technology: Vol. 9, 2024, ISSN 2734-2182

As our understanding of the relationship between lifestyle and glaucoma continues to evolve, it is important for individuals to consider these factors as part of their overall health management.

Exercise: In an article review by Glaucoma Research Foundation, it is stated that one recent study showed that moderate to vigorous physical activity decreased the average rate of visual field (VF) loss by approximately 10%. Another study reported that aerobic exercises at a brisk level for 30 – 40 minutes three to four times a week reduced IOP and improved blood flow to the eye and brain. Such aerobic exercises include:

- Walking
- Swimming
- Workout on stationary machines
- Biking

Exercises to avoid include

- Weight training that involves lifting weight of more than 10 pounds
- Valsalva maneuver – a forced expiration against a closed glottis.

Yoga: Some yoga exercises like Tarak ocular exercise might decrease IOP but should avoid those type that involves inversions e.g.

- The Adho Mukha Svanasana yoga position popularly called “Downward-facing dog”
- The Viaparita Karani position “Legs up the wall”
- The Halasana position called “Yoga plow”

Diet: Research shows that the Mediterranean diet may help protect people with glaucoma. Such diet consists mainly of olive oil, legumes, fruits, unrefined cereals, vegetables, fish and moderate consumption of dairy and wine.

Dietary Supplements: use with caution under the supervision of your physician as many supplement claims are false.

Sleeping Positions: Research reveal that IOP is higher when sleeping face up (supine) or on the side hence it is recommended that patients with glaucoma sleep with the head elevated 20 to 30 degrees which help lessen the effect of the supine position.

Cigarette Smoking: More evidence-based research is needed on the impact of smoking on glaucoma. Some research suggested that smoking was associated with faster progression of glaucoma. Other studies have reported that smoking increases the risk of various diseases including those that affect the eye (cataract and diabetic retinopathy). Source: Glaucoma Research

Foundation May 14, 2021).

Implication for nursing practice

This seminar makes it imperative for Nurses to focus more on their following roles for more effectiveness in glaucoma management:

Preventive Role: The nurse should conduct comprehensive assessment on patients particularly those above the age of 40 years using the nursing process to identify and diagnose patients who are at risk for glaucoma to plan appropriate nursing interventions. Participate in public enlightenment campaigns by giving health education to raise awareness on glaucoma.

Curative Role: Monitoring of glaucoma patient intraocular pressure and assessment of optic disc to track the effectiveness of treatment or the progression of glaucoma. To identify patients with advanced glaucoma and make nursing diagnosis of risk for fall/injury related to the disease condition and develop nursing care plan for individualized care. Provide appropriate counselling to promote patient medication adherence and compliance to follow up. Be knowledgeable about possible side effects of treatments, monitor patients, and teach them how to recognize and manage them if they experience any

Rehabilitative Role: Collaborate with other team members to provide care tailored to patient specific needs e.g low vision aids and useful resources for rehabilitation of the blind. Providing counselling and psychological support to patient caregiver.

Promotive Role: Help educate glaucoma patients on effective lifestyle modification to improve patient overall quality of life. Contribute to the development of policies to augment cost of medication and other treatment strategies. Participate in research on glaucoma, publish findings and contribute to evidence-based practice (EBP). Continuing professional development by acquiring necessary skills and knowledge relevant for practice and in line with development trends in management of glaucoma.

Conclusion

Glaucoma with its insidious progression and devastating consequences demands heightened awareness, early detection, and effective management strategies. This seminar aimed to shed light on this condition's multifaceted nature, emphasizing the critical need for continued research in areas of diagnosis, management, neuroprotection and regeneration of damaged optic nerve for vision restoration, enhanced health care access and comprehensive patient care to combat this silent threat to

vision and promote optimal level of overall quality of life of glaucoma patients.

Recommendations

1. Health care professionals should use more of mass media and public gatherings to create more awareness on glaucoma
2. Nurse's especially Ophthalmic nurses should work in collaboration with public health nurses to carry out regular eye health services as a component of school health services.
3. Government / Non-profit organizations should partner to provide subsidization of cost of treatment of glaucoma.
4. Employers (Government) should invest more in the training of ophthalmic professionals on current trends in glaucoma management.
5. Health care planners and policy makers should advocate for policies to integrate electronic technologies such as Teleglaucoma in public health institutions particularly in the rural areas
6. Free screening programs should be organized and conducted more frequently than the usual World Glaucoma Week (WGW) activities which take place annually in March.

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