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CONTENTS

ABSTRACTS OF SELECTED ORAL PRESENTATIONS

When do we start glaucoma treatment: new concepts for pre-perimetric glaucoma?

Dr. S. Fabián Lerner, *MD (Argentina)*

In this session, the speaker Dr. Fabián Lerner discussed 2 case reports of patients with intraocular pressure (IOP, 25 mm Hg [case 1] and 24 mm Hg [case 2]) to decide whether to treat them for glaucoma. The speaker emphasised and discussed the findings of previously conducted phases 1, 2 and 3 of the Ocular Hypertension Treatment Study (OHTS).[1]

Characteristics of the 2 patient cases discussed

	Case 1	Case 2
Age (years)	72	78
Race, sex	White, male	White, female
VA OU	20/20	20/30
BMC	s/p	s/p
IOP (mm Hg)	25	24
CCT (µm)	510	560
VF	normal	-
C/D	~0.6	~0.1–0.2
PSD (dB)	1.40	1.15

BMC, biomicroscopy; CCT, central corneal thickness; C/D, cup to disc ratio; IOP, intraocular pressure; PSD, pattern standard deviation; VA OU, visual acuity oculus uterque (both eyes); VF, visual field.
Adapted from: Lerner F. 2022.

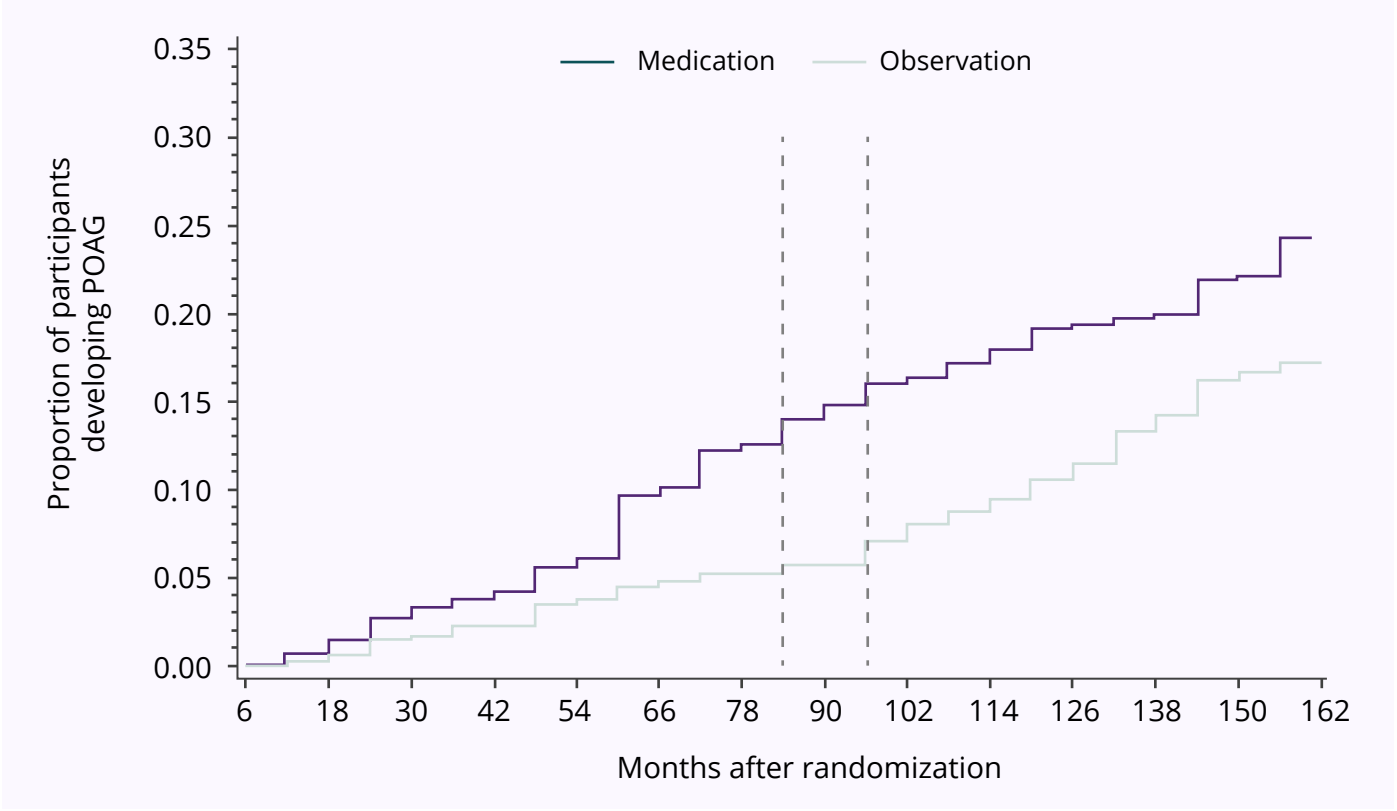
The phase 1 OHTS (study period: 1994–2002; comparators: medication group vs observation group) demonstrated that at 5 years, the cumulative probability of developing primary open-angle glaucoma (POAG) was significantly lower in the medication group compared with the observation group (4.4% vs 9.5%; $p<0.0001$). The IOP reduction was 22.4% and 4% in the treatment and observation groups, respectively.[1,2] The important predictive factors for the development of glaucoma in clinical practice included age (>59 years), IOP (>25 mm Hg), central corneal thickness (CCT, <554 µm), vertical cup/disc (C/D) ratio (≥0.5) and pattern standard deviation (PSD, 1.98 dB).[1,3]

The predictive factors were applied in a risk calculator, and the results showed that the estimated 5-year risk (%) of developing glaucoma in at least one eye for case 1 patient was 35.0% and for case 2 patient was 7.4%. The speaker stated that in simulated case scenarios, glaucoma specialists changed their recommendations when including a risk calculator and the recommendations were more consistent with the published results of the OHTS.[1]

The phase 2 OHTS (study period: 2002–2008) was designed to determine if delaying the treatment with medications was detrimental to patients in the observation group.

The study compared the observation group (initial observation period: mean, 7.5 years; treatment period: mean, 5.5 years) with the medication group (continued treatment)[1] and demonstrated that the cumulative frequency curves of developing POAG diverged in phase 1 but become parallel in phase 2 after the initiation of the treatment. The protective effect of medications had a relatively rapid onset, and the protection was better in the high-risk group.[1,4] Furthermore, De Moraes *et al*. (2012) showed that the initiation of ocular hypotensive medication amongst OHTS participants, originally randomised to the observation group, significantly reduced the velocity of visual field (VF) progression. The greater the amount of absolute IOP reduction, the more substantial the improvement in VF change.[1,5]

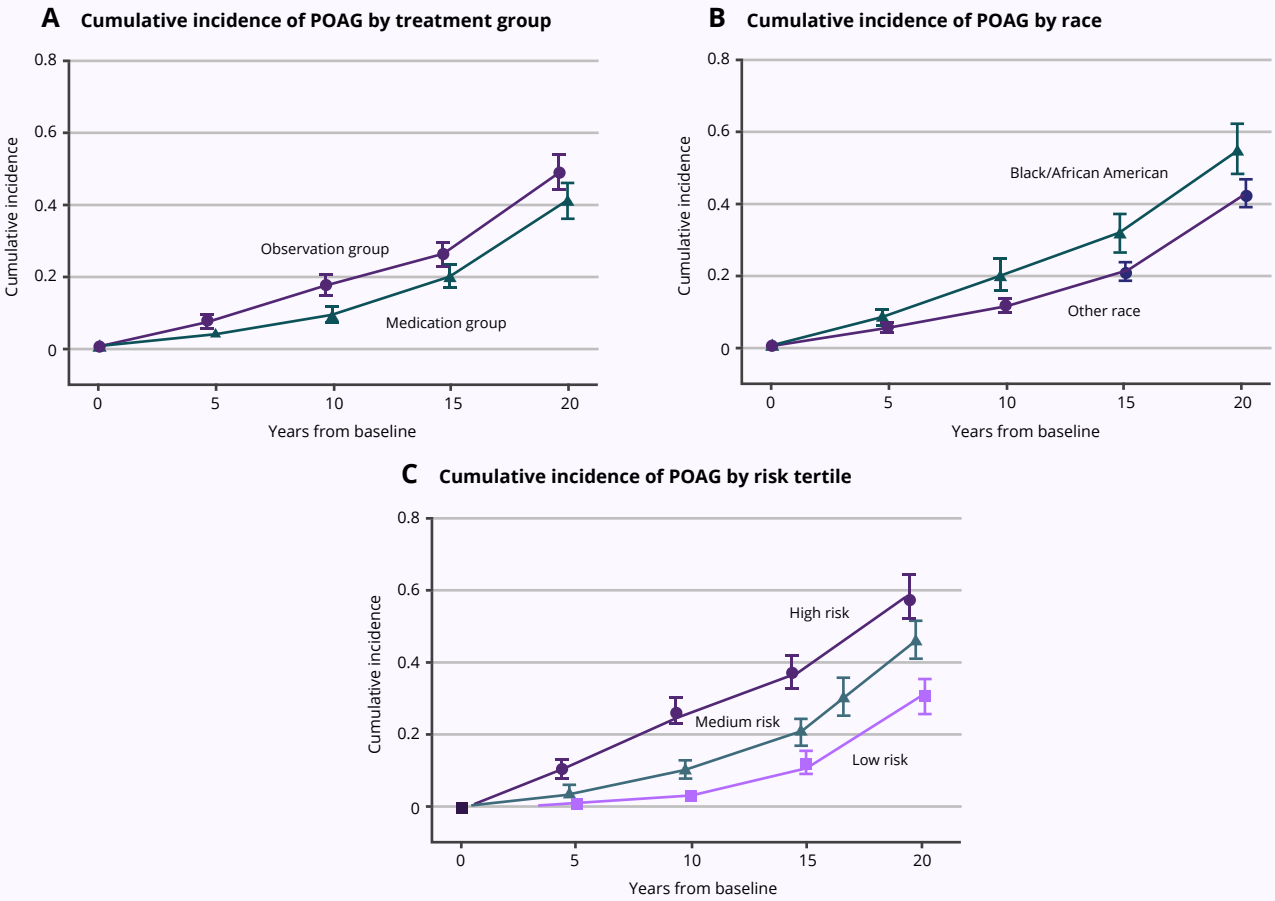
Cumulative probability of developing primary open-angle glaucoma (POAG) from February 1994 to March 2009 by randomisation group



POAG, primary open-angle glaucoma.
Note: The time between the 2 vertical lines indicates the initiation of medication in the original observation group.
Adapted from: Lerner F. 2022.

The phase 3 OHTS (study period: 2016–2019) reported the cumulative incidence of POAG after 20 years of follow-up or over lifetime (within 2 years of death). The annual incidence of POAG in one or both eyes was 2.2% amongst all participants (based on the Kaplan–Meier estimation). The 20-year cumulative incidence was 49.3% in the observation group and 41.9% in the medication group (adjusted for exposure time). African Americans had a higher incidence compared with other races (55.2% vs 42.7%). The cumulative incidences for participants in the low-, medium- and high-risk tertiles were 31.7%, 47.6% and 59.8%, respectively. The incidence was linear with a slight increase around 15 years of follow-up, but its association with increasing age could not be determined. The 20-year cumulative incidence for VF loss was 25.2%. However, it is not clear yet if early treatment reduced the severity of POAG. Furthermore, at 20 years of follow-up or within 2 years of death, the best-corrected visual acuity that was worse than 20/40 (associated with any factor) occurred in 8.6% of the participants in one eye and 2.3% of participants in both eyes. Ocular hypotensive medication was received by 72.0% of participants. The incidence of glaucoma surgery was higher amongst African Americans compared with other races (21.1% vs 17.1%).[1,6,7]

Kaplan-Meier curves of cumulative incidence of primary open-angle glaucoma (POAG) at 5, 10, 15, and 20 years



POAG, primary open-angle glaucoma.
Note: The whiskers indicate 95% confidence intervals.
Adapted from: Lerner F. 2022.

The speaker highlighted that it is important to take into consideration that the mean baseline IOP of participants in the OHTS was 24.9 mm Hg, there was a higher percentage of African American participants compared with the general population, the criteria for POAG diagnosis was rigorous and non-availability of the optical coherence tomography (OCT) results since the beginning of the OHTS.[1]

In conclusion, the speaker stated that considering early treatment for patients with OHT with high and maybe moderate risks is important. An individualised assessment of risk is useful. Factors to be discussed with the patient and taken into consideration whilst treatment include family history, social situation, lifetime expectancy, health status, possible side effects of treatment and patient preferences. Future models may include OCT information as well as genetics and other factors.[1]

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Update on OCT to diagnose and assess glaucoma progression

Dr. Christopher Leung, *MD MB ChB (Hong Kong, China)*

In this session, the speaker Dr. Christopher Leung addressed 2 questions: (1) do we need to image the macula in the assessment of glaucoma progression? and (2) do we need to provide additional intraocular pressure (IOP)-lowering therapy in patients with glaucoma having progressive retinal nerve fibre layer (RNFL)/ganglion cell–inner plexiform layer (GCIPL) thinning without visual field (VF) progression?[1]

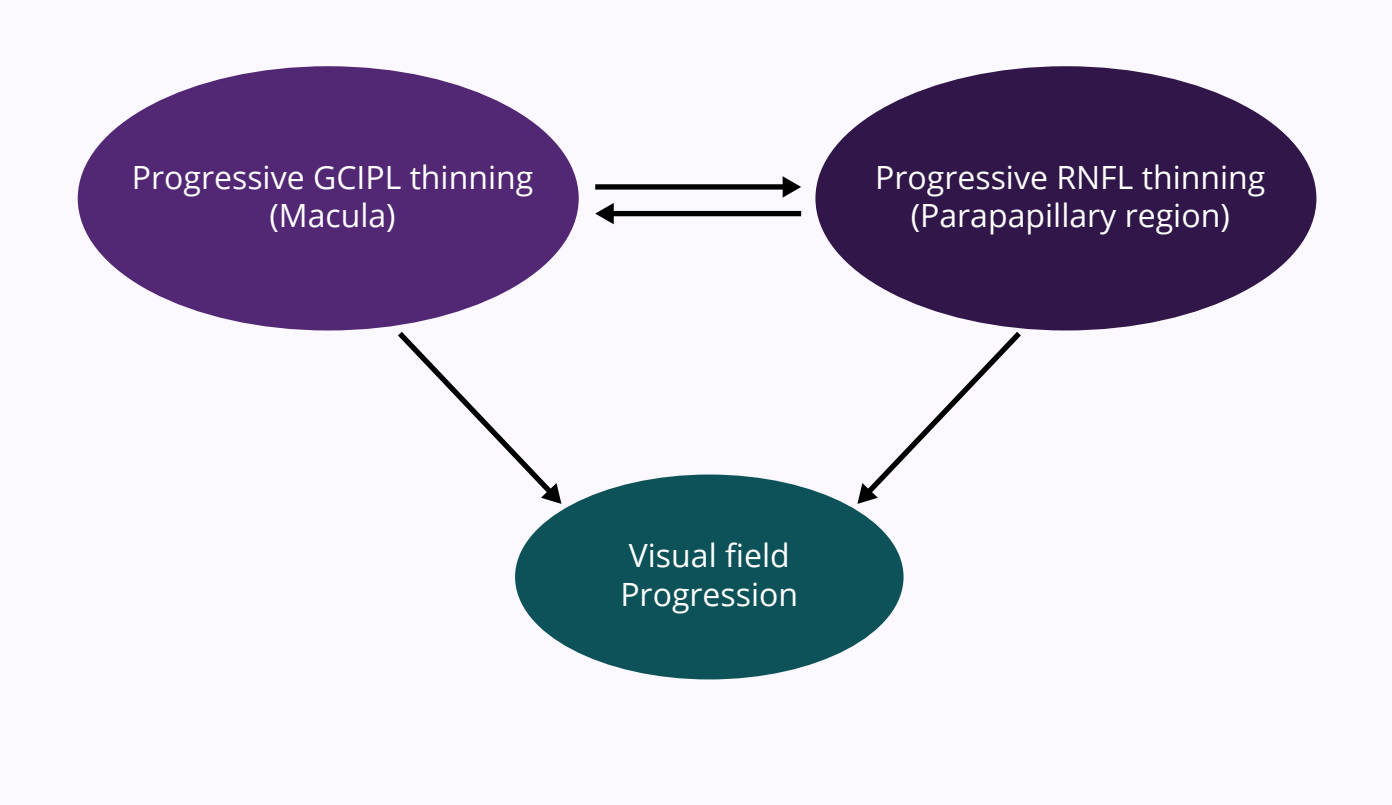
Retinal nerve fibre layer optical texture analysis (ROTA), a recently developed technology by speaker's team, uncovers the optical texture and trajectories of the individual axonal fibre bundles and reveals RNFL defects that are missed by conventional RNFL/GCIPL thickness analysis.[1,2] Applying ROTA in 204 eyes from 171 consecutively recruited patients with early glaucoma (VF mean deviation, ≥−6 dB) showed that 71.1% and 16.7% of the patients had papillomacular and papillofoveal bundle defects, respectively.[1,3] The speaker stated that macular involvement in glaucoma is very common and it is important to image the macula in the diagnostic assessment of glaucoma.[1]

The speaker suggested that the available software support of optical coherence tomography (OCT), including the event analysis (e.g. guided progression analysis [GPA] of RNFL/GCIPL thickness maps), and the trend analysis (e.g. linear regression analysis of RNFL thickness) can be used to monitor glaucoma.[1] The importance of imaging both the parapapillary region for RNFL and the macula for GCIPL was highlighted by quoting 2 patient cases. The GPA of case 1 showed the occurrence of progressive GCIPL thinning 21 months before progressive RNFL thinning, whereas in another case, progressive GCIPL thinning occurred 37 months after progressive RNFL thinning.[1]

The speaker cited a study by Hou *et al*.[4] that showed that the GPA for progressive macular GCIPL thinning and progressive parapapillary RNFL thinning is mutually predictive.[4] The speaker recommended wide-field imaging covering the macula (GCIPL±RNFL) and the parapapillary region (RNFL) in the assessment of glaucoma progression.[1]

Also, he suggested considering additional IOP-lowering therapy in patients with glaucoma having progressive RNFL/GCIPL thinning without VF progression. It is important to consider all risk factors in an individual case for the development of glaucoma progression and accordingly to treat the patients with IOP-lowering therapy. The results of the Early Manifest Glaucoma Trial (EMGT) showed that patients with IOP ≥21 mm Hg have a higher risk of developing VF progression (hazard ratio [HR], 1.77; 95% confidence interval [CI], 1.29–2.43; p=0.0005),[5] thus providing a rationale for considering IOP-lowering therapy in these patients.[1,5] In another study conducted by speaker's group, patients with progressive RNFL thinning detected by the GPA had an ~4-fold higher risk of VF progression (HR, 3.95; 95% CI, 1.74–8.93; p=0.001 [EMGT criteria] and HR, 3.81; 95% CI, 1.83–7.92; p<0.001 [pointwise linear regression criteria]).[6] The speaker cited another case that described a patient in whom the progressive RNFL thinning was detected (by GPA) 33 months prior the VF progression (GPA and EMGT) and emphasised that the longer time gap provides a window to prevent vision loss in these patients.[1]

Integrating ganglion cell inner plexiform layer (GCIPL) and retinal nerve fibre layer (RNFL) for glaucoma detection



GCIPL, ganglion cell–inner plexiform layer; RNFL, retinal nerve fibre layer.
Adapted from: Leung C. 2022.

The progressive GCIPL thinning also predicts the development of likely (HR, 3.48; 95% CI, 1.51–8.01; *p*=0.003) and possible (HR, 2.74; 95% CI, 1.26–5.98; *p*=0.011) VF progression.[4] Hence, the speaker highlighted that progressive GCIPL thickness (macula) and progressive RNFL thinning (parapapillary region) are mutually predictive and both predict VF progression.[1,4]

The speaker concluded the session by suggesting that in patients with glaucoma having progressive RNFL/GCIPL thinning without VF progression, additional IOP-lowering therapy needs to be considered because these eyes are at a higher risk of developing subsequent VF loss.[1]

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Can neuroregeneration reverse glaucoma?

Dr. Keith Martin, *DM FRCOphth FRANZCO FARVO ALCM (Australia)*

The speaker Dr. Keith Martin discussed about various parameters to consider while treating patients with glaucoma, primarily on what should be done when intraocular pressure reduction is insufficient to stop progressive visual loss in glaucoma. Secondly, whether vision can be restored once it has been lost in glaucoma and whether can we rescue damaged retinal ganglion cells (RGCs) or regenerate injured optic nerve axons and replace or regenerate lost RGC.

Gene therapy is a tool for neuroprotection and neuroregeneration.

- Gene therapies are making good progress for a rare, single gene defect inherited retinal diseases (Leber's congenital amaurosis, Leber's hereditary optic neuropathy and choroideraemia).
- At present, gene therapies are being developed for treating common eye diseases without a single gene defect, such as glaucoma, age-related macular degeneration and diabetic retinopathy.[1]

The speaker's group developed a gene therapy candidate for glaucoma that is very effective in protecting RGC in the animal model. This gene therapy works by enhancing brain-derived neurotrophic factor (BDNF) signalling. The combined tropomyosin-related kinase B (TrkB)-BDNF gene therapy demonstrated a strong neuroprotective effect in experimental glaucoma models, and the speaker's group observed increased survival of RGC from 46% to 84% (70% rescue).

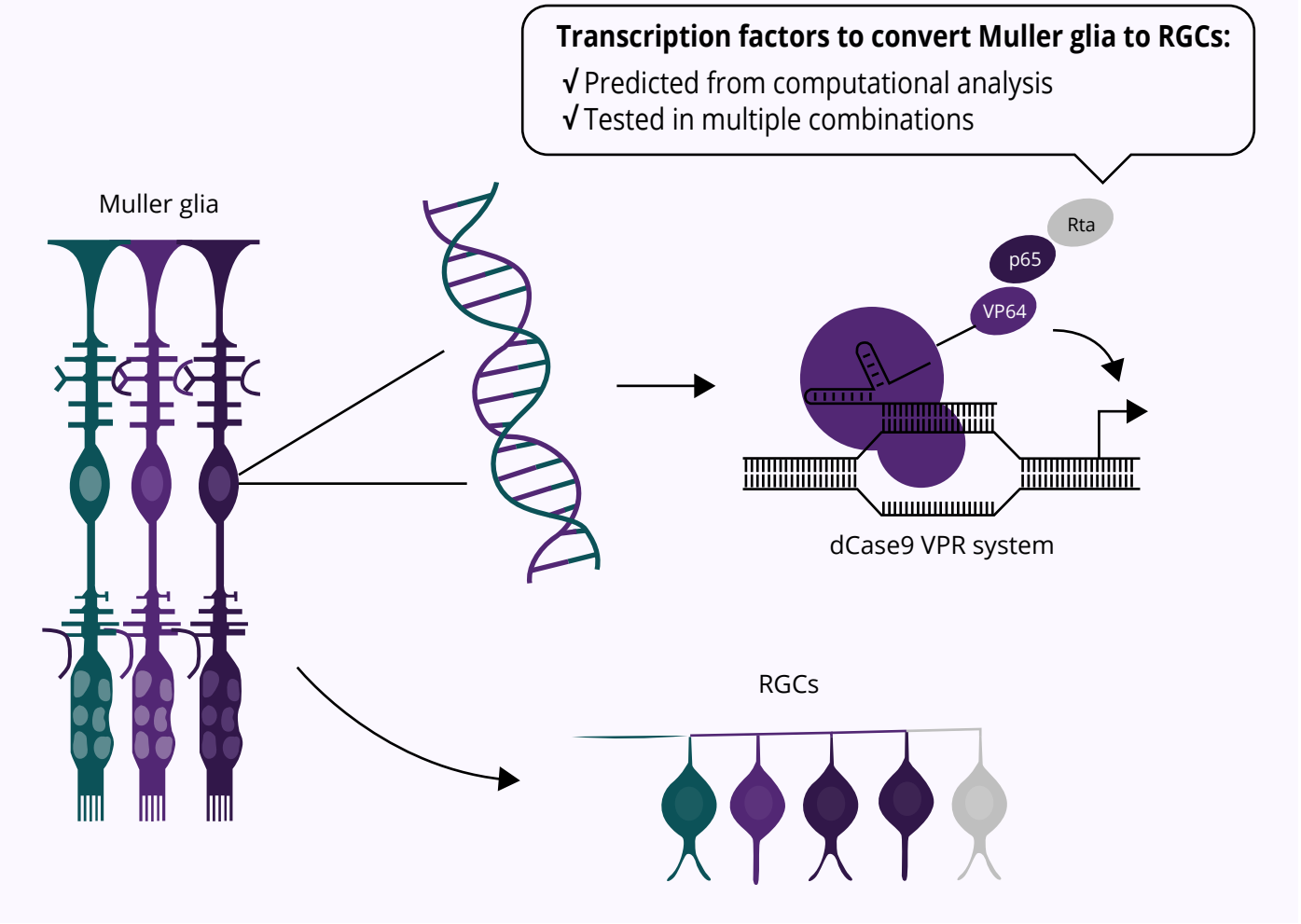
The speaker stated that the gene therapy can target many other pathways as well. The most promising targets of this gene therapy can be mitochondria, the optic nerve head to make it more resistant to injury or trabecular meshwork to improve aqueous humour flow. In this talk, the speaker has concentrated on whether gene therapy can be used to stimulate regeneration of RGC axons, and whether it can be used to reprogramme or replace lost RGCs. At first, the speaker discussed if gene therapy can be used to regenerate the optic nerve.

The speaker discussed that adult central nervous system (CNS) axons have a poor intrinsic regenerative ability after injury. The fundamental question raised in the speaker's basic research was why the CNS cannot deal with insult or injury and how CNS axons can be protected and made better regenerators similar to the optic nerve. The RGC regeneration is possible by inducing a pro-regenerative response in the retina (intrinsic strategy) and reducing an inhibition of regeneration throughout the optic nerve (extrinsic strategy). Zymosan and arylsulphatase B, a clinically approved human enzyme, enhance optic nerve regeneration.[1]

Transport failure beyond the axon initial segment in adult CNS axons prevents regeneration. The speaker stated that the molecule protrudin is a potential candidate to enhance regeneration. Protrudin acts as a scaffolding molecule, bringing together multiple other molecules at the tip of the growing axons. The series of experiments done by the speaker's group showed that the gene therapy with protrudin and activated protrudin stimulates CNS axon regeneration in vitro. Protrudin overexpression was shown to be a strong promoter of axon regeneration after laser axotomy.[1]

If RGC bodies are lost, Müller glial cells (MGCs) can be targeted for gene therapy. MGCs are abundant, have stem cell properties and can be targeted by adeno-associated virus vectors with high efficiency and specificity. The speaker stated that when retina is injured in fish and amphibians, the retina has the ability to regenerate by de-differentiating MGCs and producing new RGCs. The genes that reprogramme human MGCs into photoreceptors have been identified. The MGCs are reprogrammed into photoreceptor cells, which expressed the right proteins that are functional and similar to the adult photoreceptors. Similarly, MGCs are reprogrammed into RGCs using the clustered regularly interspaced short palindromic repeats activation (CRISPRa) technology.[1]

Direct reprogramming of Muller glia cells into retinal ganglion cells (RGCs) using CRISPRa



CRISPRa, clustered regularly interspaced short palindromic repeats activation; dCas9, catalytically dead CRISPR–associated protein 9; RGC, retinal ganglion cell; VPR, VP64-p65-Rta.
Adapted from: Martin K. 2022.

The speaker concluded that the regeneration of the optic nerve is possible, at least in animal models. Several approaches can be used to stimulate the regrowth of RGC axons. Renewal or replacement of RGCs is possible through reprogramming. The restoration of spatial vision is unlikely to be achieved with one approach alone. It will require multiple strategies to protect, repair, replace, regenerate and enhance optic nerve function.[1]

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1. Martin K. Can neuroregeneration reverse glaucoma? ICO Member Society: European Glaucoma Society session presented at 38th World Ophthalmology Congress (WOC) 2022 (Virtual), Topic: Glaucoma, Session: Treats from the EGS congress in Athens 2022. 9 September 2022.

The new EGS Patient Project: communication with the patient

Dr. Stelios Georgoulas, *MBBS MSC PhD FEBP FRCOphth PGDCRS (United Kingdom)*

The speaker Dr. Stelios Georgoulas discussed the key objectives of the new European Glaucoma Society (EGS) Patient Project (European Patients' Questionnaire) to better understand the glaucoma patients and their needs and how they differ across Europe. At present, patients are under-represented in significant decisions taken for them; hence, it is required to increase patient involvement and public awareness and to identify their unmet needs in glaucoma care and treatment. These measures also help others (e.g., industry, national health systems) to better support patients. The EGS patient involvement initiative involves short-, medium- and long-term goals.[1]

Goals of the EGS patient involvement initiative

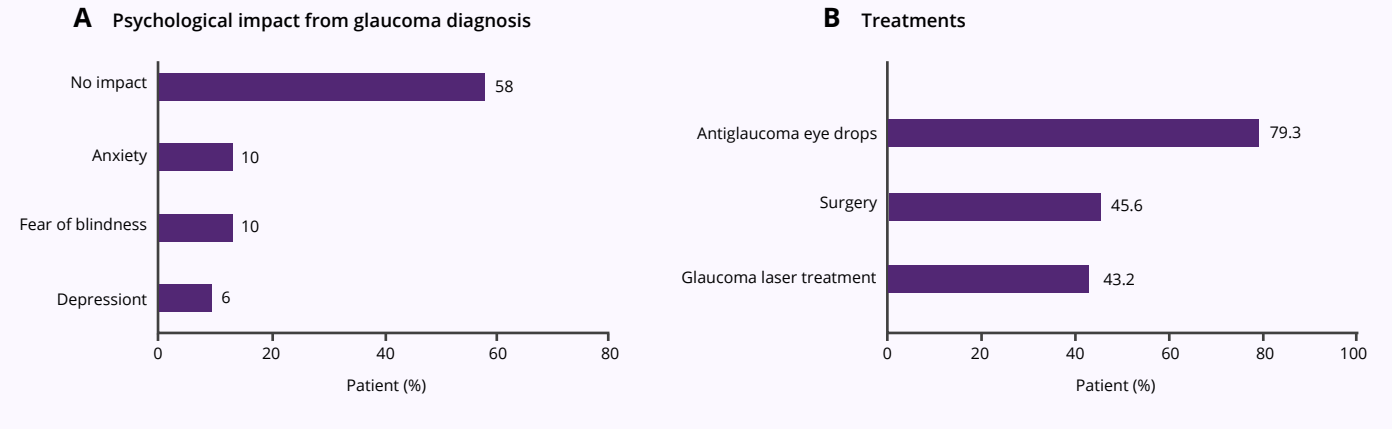
Short-term goals	Medium-term goals	Long-term goals
• Map the presence of patient organisations in Europe	• Understand the patients' unmet needs	• Help to create European-wide structured patient communication channels, with EGS acting as an umbrella
• Understand the cultural background	• Plan questionnaires/ interactive sessions to receive measurable and structured feedbacks	• Communicate findings to doctors, politicians, researchers and industries
• Understand the level of support by organisations in each country	• Understand patients' perspectives on research priorities	

EGS, European Glaucoma Society.
Adapted from: Georgoulas S. 2022.

The speaker stated that at present, the project is at the medium-term stage wherein a questionnaire was circulated amongst the patient support organisations in Europe, and a measurable and structured feedback was received.[1]

The speaker presented the preliminary results (as of 12 June 2022) of the first EGS patient's questionnaire. The first results were analysed in early June 2020, and a second larger analysis is planned at the end of September 2022. A total of 402 responses were received from patients across 20 different countries in a period of 3 weeks. The majority of the responses received were from patients in the United Kingdom (UK; 67.4%, n = 271), followed by Germany (9.0%, n = 36) and France (8.5%, n = 34). A total of 85.1% (n = 342) of patients received a glaucoma diagnosis, and the remaining patients were either glaucoma suspects or with ocular hypertension. The majority of the glaucoma suspects in the European population were white patients (93%, n = 371), had received higher education (68.8%, n = 271), were female patients (53.2%, n = 214) and were aged 60 to 79 years (61.4%, n = 247). Approximately 79.3% (n = 277 of 349) of patients were treated with antiglaucoma eye drops, 43.2% (n = 150 of 347) of patients received laser treatment and 45.6% (n = 159 of 349) of patients had undergone surgery for glaucoma management. The speaker highlighted that the psychological impact of the patients from glaucoma diagnosis was an important question that needed to be included in the questionnaire, and 42% (n = 98 of 233) of patients experienced a negative psychological impact. Of the 233 responses received, 135 patients reported no psychological impact, 24 patients experienced fears of blindness as well as anxiety and 14 patients experienced depression.

Preliminary results of the first EGS patient's questionnaire on patient diagnosis, treatment and their psychological responses



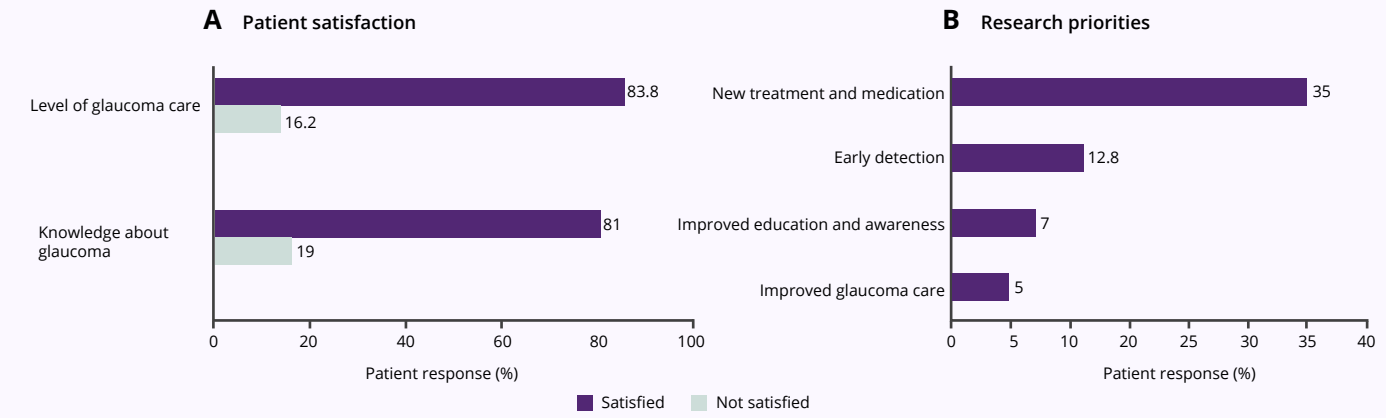
EGS, European Glaucoma Society.
Adapted from: Georgoulas S. 2022.

More than 80% (n = 282 of 348) of patients were satisfied with their level of glaucoma education. However, as there were insufficient simple explanations of their condition and long-waiting times or limited access to glaucoma consultants in Europe, information was sourced by the patients themselves. The speaker mentioned that the comments were similar across different parts of Europe. The patients complained about insufficient information, especially while visiting doctors in public sectors, and that the official information provided at the hospitals were focussed on the clinical aspects of treatment, not on (secondary) prevention and behaviour.[1] Although 83.8% (n = 294 of 351) of patients were satisfied with their glaucoma care, negatives included long-waiting times between appointments and in hospitals, rushed consultations and not being offered all treatment options.[1]

Furthermore, 55% patients from the UK reported easy access to glaucoma specialists in the public sector but with a long-wait period. A total of 41.7% patients from Germany mentioned that appointments in the public sector had a long-waiting time, whereas it was very easy to get appointments in the private sector. However, 48.1% patients from France reported that getting appointments was difficult in both private and public sectors. Common challenges that patients face with respect to glaucoma treatment are as follows: 20.9% of patients stated that they struggle with stabilising their glaucoma, 15% of patients struggle with the side effects of the drops and 13.4% of patients struggle with remembering to apply their medication. Patients wanted to receive more frequent appointments and no cancellations or postponements of scheduled appointments (14 of 64 suggestions), as well as better information about their condition and treatment options (13 of 64 patients).[1]

In addition, 54.4% (n = 216) of patients were not aware of patient support organisations in their countries; 76.6% (n = 199) of patients believed that support organisations would be very helpful. However, 35.3% (n = 88) of respondents received educational materials, and 27.8% (n = 63) of respondents only participated in events organised by the support organisations. Majority of patients (35%, n = 82) responded to prioritise research on new treatments and medications, whereas 12.8% (n = 30) of patients preferred early detection of glaucoma.[1]

Preliminary results of the first EGS patient's questionnaire on patient information and satisfaction levels, and research priorities



EGS, European Glaucoma Society.
Adapted from: Georgoulas S. 2022.

The immediate next steps of the EGS patient involvement initiatives are to translate the questionnaire into 6 to 10 languages by the end of summer 2022; to distribute it through national organisations, hospitals and clinicians across Europe; and to organise a discussion panel in September 2022 between the research priorities committee and patients to evaluate patients' opinion on key research priorities in glaucoma.[1]

References

1. Georgoulas S. The new EGS Patient Project: communication with the patient. ICO Member Society: European Glaucoma Society session presented at 38th World Ophthalmology Congress (WOC) 2022 (Virtual),Topic: Glaucoma, Session: Treats from the EGS congress in Athens 2022. 9 September 2022.

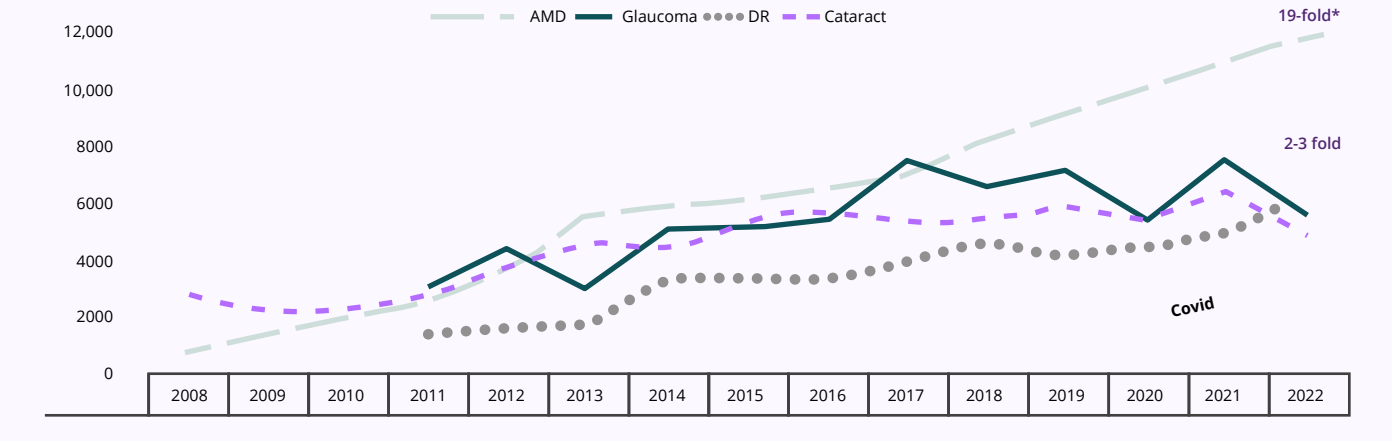
Health and economic burden of glaucoma

Professor Anja Tuulonen *(Finland)*

The European Glaucoma Society (EGS) defines its vision as achieving outcomes such as individuals (includes patients, citizens [taxpayers], and society) with glaucoma having minimal glaucoma-induced visual disability and best possible well-being, within an affordable healthcare system. From a global perspective, to achieve the above outcomes, and for solving the global imbalance, imitating the very high densities of ophthalmologists in developed countries into developing countries will be ineffective, because the treatment itself is very expensive in developed countries. Western countries spend more money and generate more healthcare services and the citizens live longer and healthier, and, simultaneously, the demand of services and cost continue to increase exponentially.[1]

The reasons for blindness are different in developed and developing countries. In Finland, the 'Big 4' (age-related macular degeneration [AMD], glaucoma, diabetic retinopathy [DR] and cataract) accounted for 70% of eye diseases. Glaucoma, AMD, and DR caused permanent blindness, but no patients were blind because of cataract. In addition to glaucoma treatment, it is important to consider all 4 eye diseases. The number of AMD treatments increased much faster compared with other eye disease treatments at Tays Eye Center, Tampere, Finland.[1]

Increases in the 'Big 4' at Tays Eye Center



AMD, age-related macular degeneration; DR, diabetic retinopathy.
Note: *increase varies between 10- to 25-fold amongst 5 university eye clinics
Adapted from: Tuulonen A. 2022.

In 2015, EGS identified increasing demand, misdiagnosis (both under [~50%] and simultaneous over care [50%]) and suboptimal resource utilisation as the biggest challenges in glaucoma care. In spite of the EGS guidelines and the latest updates, an overview of systemic reviews reported a high degree of uncertainty in the effectiveness of glaucoma interventions. When the efficacy outcomes of randomised control trials (RCTs) were implemented in everyday practice, the variability was significantly higher in patients with several comorbidities, practitioners with varying levels of experience and variable protocols in spite of available guidelines. In addition, patients in real-world have two eyes compared to one eye patients included in the RCTs. Therefore, evaluations are required at the patient and system levels to understand how the patients are seeing and doing in everyday practice.[1]

In the real-world monitoring and collecting data, automation, full coverage of data, single data entry and easy to read outputs are crucial when comparing data between units. To evaluate the cost-effectiveness, in addition to demand and productivity, the data on real-world outcomes, quality of life (QoL) and costs are required. At Tays Eye Center, to measure the well-being of 200 pilot patients, a 15-dimensional (15D) QoL questionnaire (includes a question on vision) was used to distinguish the general population from patients with glaucoma, AMD and visual disability. To determine whether adequate glaucoma care is provided, the speaker suggested collecting and analysing the real-world data and comparing the outcomes, nationally and internationally. Since 2008, Tays Eye Center collected and offered the real-world data of >12000 patients with glaucoma for benchmarking.[1]

References

1. Tuulonen A. Health and economic burden of glaucoma. Invited session presented at 38th World Ophthalmology Congress (WOC) 2022 (Virtual), Topic: Glaucoma, Session: Comprehensive approach to glaucoma care. 12 September 2022.

Glaucoma and real-world disability

Dr. Pradeep Ramulu, *MD MHS PHD (United States)*

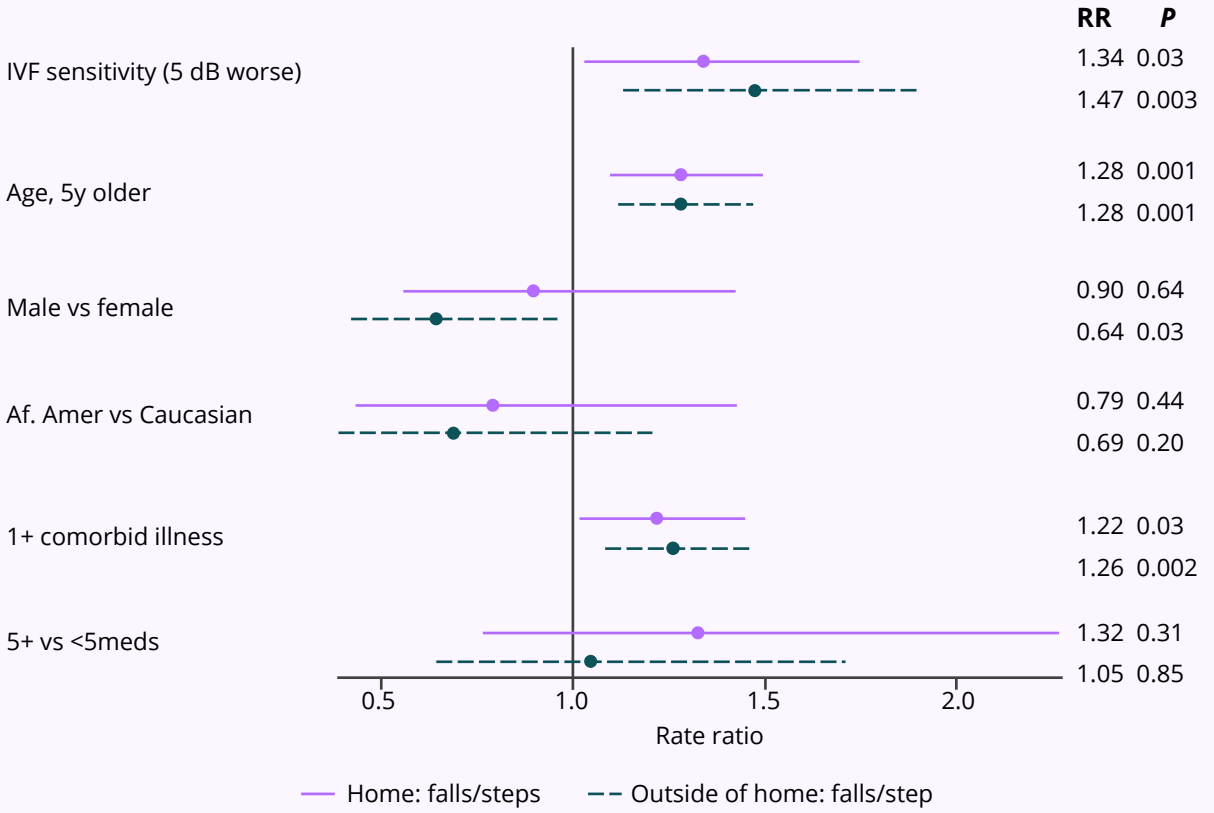
In this session, the speaker Dr. Pradeep Ramulu discussed about the model of visual disability. Visual impairment (VI) may affect physical, cognitive and psychological and social functioning.[1] Reduced functioning leads to negative health outcomes, including frailty, disability, comorbidity and mortality. Common risk factors (including vision, personal and environmental) that affect eye health and overall health may simultaneously influence relationships amongst VI, functioning and health outcomes.[2] The speaker stated that reality has two levels: one is what the patient perceives and the other is what actually happens to them. In a self-reported scenario by patients, what the patient perceives is all of the reality; however, in general, when glaucoma is evaluated completely, it affects not just patients but also their families, caregivers, healthcare providers and society as a whole.[1] Therefore, the patient-reported outcome measures should be complemented with the objective measurements of glaucoma. Glaucoma influences the self-reported quality of life (QoL), and the speaker studied several self-measures of vision using QoL outcome measures, amongst which the contrast sensitivity was most associated with the QoL in patients with glaucoma.[1,3]

The speaker also discussed how the patient disability relates to caregiver burden and their QoL. The informal caregiver (ICG) strain increases in patients with advanced visual field (VF) loss. The modified caregiver strain index (MCSI) was much higher (5.6 [4.9]) in such patients. There was a strong correlation amongst worsening ICG, MCSI, worsening VF and poorer self-reported general health (EuroQol–5 dimension [EQ5D]).[4] Glaucoma was more associated with silent reading (−17% [−32 words per minute {wpm}]) for a longer period of time than reading out loud (−13 wpm). Glaucoma has borderline association with comprehension (p=0.06). The reading speed also decreased over time in patients with glaucoma compared with controls.[1]

Visual field damage with an increased severity of glaucoma has been associated with driving cessation. Significant restrictions in driving were observed amongst patients with VF loss and glaucoma. Patients with glaucoma have 4 times more likelihood of giving up driving than controls who were glaucoma suspects.[5] Patients with severe glaucoma have worse on-road driving and higher per-mile crash rates.[1]

Visual field damage from glaucoma leads to higher fall rates at and away from home. Falls that occur away from home are more likely to cause injury. Different measures are required to prevent falls within and away from home.[1]

Association between rates of falls at home and away from home per step with degree of visual field damage



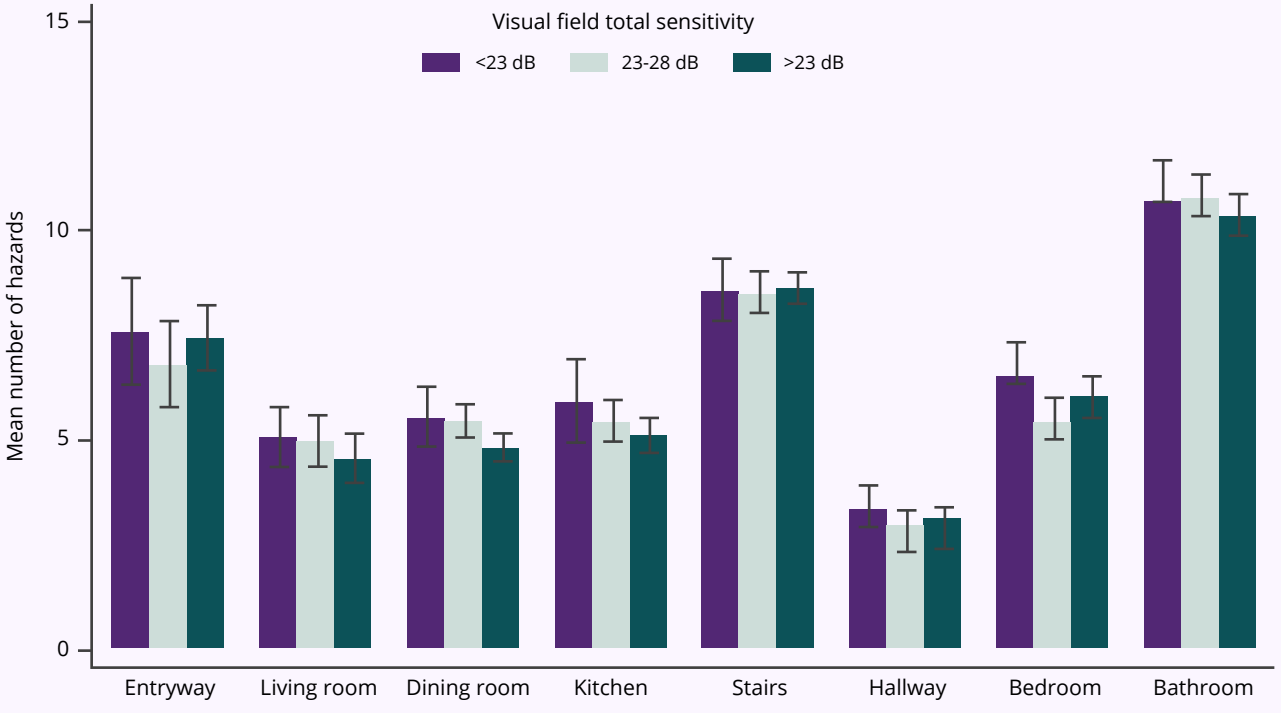
Af. Amer, African American; dB, decibel; IVF, integrated visual field; meds, medications; RR, rate ratio.
Adapted from: Ramulu P. 2022.

Patients' neighbourhood characteristics also contribute to their limitations of activities and disability. Patients with severe glaucoma were significantly more impacted by poverty and crime rates compared with those with mild glaucoma.[1]

The speaker also highlighted that there are many hotspots in the home that are more hazardous where patients with glaucoma may slip and fall. Maximum falls happen on stairs (9 falls [24.8%], 8 injurious [19.5%]), in bedrooms (22 falls [18.8%], 8 injurious [19.5%]) and in bathrooms (17 falls [14.5%], 6 injurious [14.6%]). Patients may need help to make the home alterations that will improve their safety. Neither the total number of hazards (rate ratio [RR], 1.18; 95% confidence interval [CI], 0.46–3.05) nor the percentage of items graded as hazardous (RR, 0.92; 95% CI, 0.79–1.07) were associated with a higher fall rate.[1] Patients with glaucoma who are at risk for falls need assistance in modifying their homes and improving lighting within their homes to make them safer.[1]

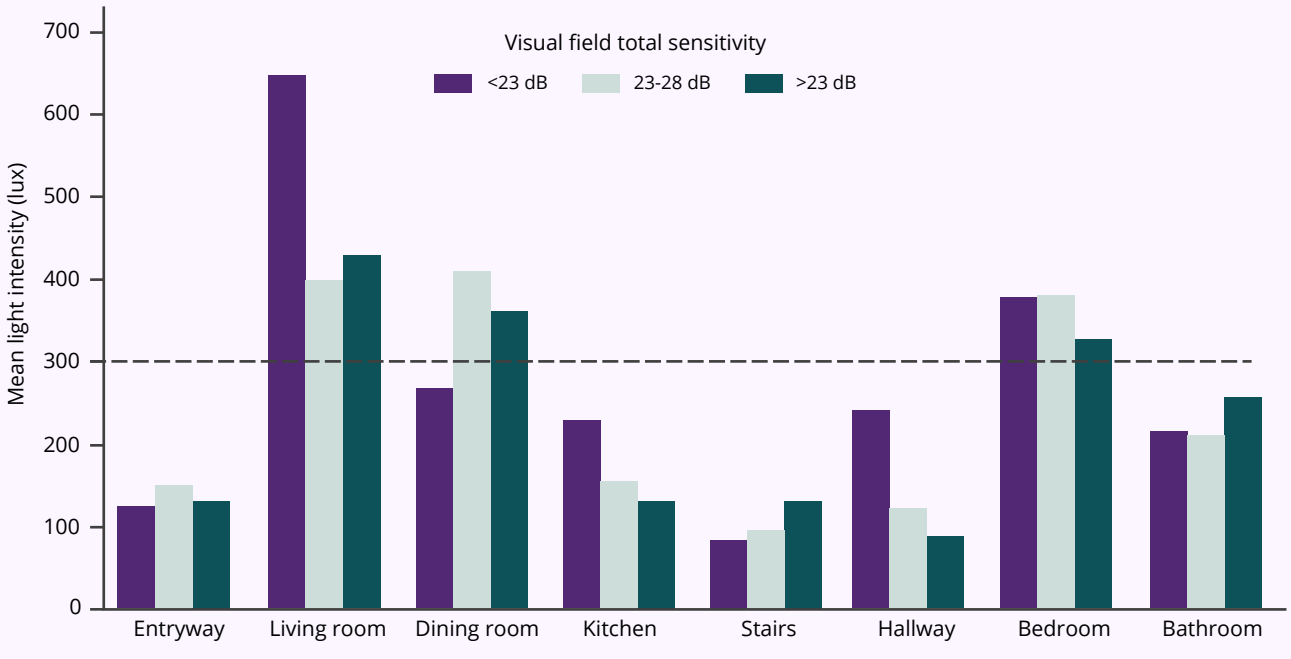
Better lighting is associated with fewer falls. The speaker recommended to increase lighting to 300 lux or more. Each 10-fold increment in lighting was associated with a 35% lower rate of falls per year (RR, 0.65; 95% CI, 0.46–0.92).[1]

Mean number of hazards by integrated visual field sensitivity



dB, decibel.
Adapted from: Yonge AV. 2017.

Mean intensity of room lighting by integrated visual field sensitivity



dB, decibel.
Adapted from: Yonge AV. 2017.

The speaker concluded that the patients are affected by their disease in the real-world setting. The real-world disability is not just confined to the patient but also affects others such as caregivers, family and society. Disability is not purely a function of poor vision; other factors such as social situation and environment also play a crucial role.[1]

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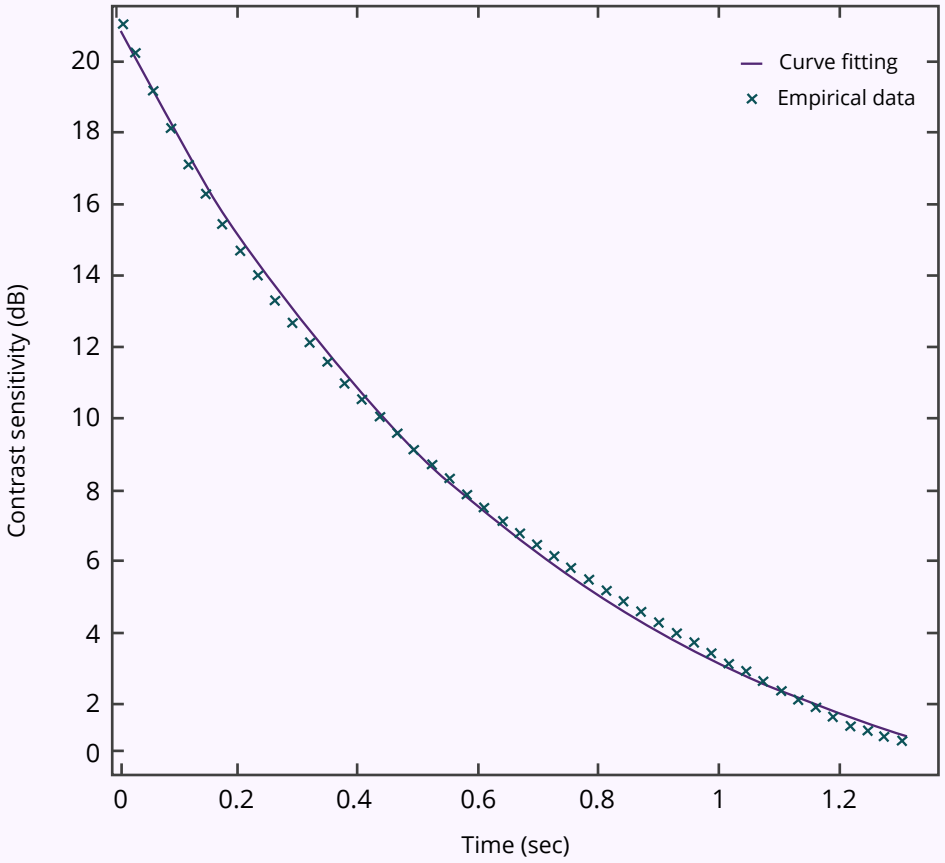
The most anticipated advance in the coming decade in glaucoma

Assoc. Prof. Visanee Tantisevi, MD *(Thailand)*

More than 2.7 million Americans aged >40 years have glaucoma, and the number is estimated to be more than double by 2050. The glaucoma spectrum evolves as undetectable, asymptomatic or progressive disease. Major challenges for physicians include how to differentiate glaucoma from non-glaucoma and how to detect glaucoma early. In glaucoma, convolutional neural networks may help glaucoma specialists in detecting the disease based on either imaging or visual field data. Deep learning (DL) may allow a more reliable diagnosis at an early stage, allowing timely intervention and improved visual prognosis. DL algorithms have been developed to work on disc images, optical coherence tomography (OCT) images (to denoise or de-shadow and to standardise OCT data for diagnosis and prognosis and for device independency), archetypal analysis of visual fields and structural correlation between optic nerve head and OCT including structure-function correlations.[1]

In this session, the speaker discussed a novel time until perceived (TUP) virtual reality (VR) perimetry, called GlauCUTU, as an alternative to the Humphrey visual field testing that is large, immobile and may not be available in some areas. GlauCUTU can be used for glaucoma screening by measuring TUP and reporting GlauCUTU sensitivity. The present study developed machine learning (ML)- and DL-based transformation algorithms that allow conversion from GlauCUTU sensitivity to Humphrey field analyser (HFA) sensitivity that can be measured in decibel (dB) units. The aim of the study is to enhance the GlauCUTU VR system's reliability and applicability for glaucoma screening and to detect severity classification with results clinically interpretable as those of HFA.[1]

The relationship between GlauCUTU sensitivity and time



dB, decibel.
Adapted from: Tantisevi V. 2022.

The findings showed that the average GlauCUTU test time (<290 seconds) was much lower compared with HFA (600 seconds) for both eyes. Comparisons amongst HFA, GlauCUTU-ML, and GlauCUTU-DL examined using visual field index (VFI) showed no significant difference between the VFI of GlauCUTU-ML and GlauCUTU-DL and HFA for the entire dataset. GlauCUTU produced the results clinically comparable with HFA using the novel automated transformation, which enabled the conversion of GlauCUTU sensitivity into HFA sensitivity. The predicted sensitivity mappings from GlauCUTU-ML and GlauCUTU-DL produced promising patterns that were similar to HFA. Advantages of GlauCUTU over HFA include lower average test duration that decreases test-induced eye fatigue leading to more reliable results, portable and comfortable head-mounted VR device, and lower cost (GlauCUTU vs HFA device: 1000 USD vs 40,000 USD). The limitation of the GlauCUTU's current version is the need for manual work during the calibration.[1]

In conclusion, the speaker mentioned that the GlauCUTU and the novel automated transformation can potentially increase accessibility to accurate glaucoma screening in lower-income or remote areas. Moreover, it will be beneficial to both the healthcare system and patients by serving as an applicable and affordable screening tool for glaucoma to prevent delayed diagnosis and treatment. The field of glaucoma management is evolving with the hope to reduce or even eliminate the chance of irreversible blindness from glaucoma.[1]

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Abbreviations

15D	15 dimensional
AMD	age-related macular degeneration
BDNF	brain-derived neurotrophic factor
BMC	biomicroscopy
C/D	cup/disc
CCT	central corneal thickness
CI	confidence interval
CNS	central nervous system
CRISPRa	clustered regularly interspaced short palindromic repeats activation
dB	decibel
DL	deep learning
DR	diabetic retinopathy
EGS	European Glaucoma Society
EQ5D	EuroQol–5 dimension
GCIPL	ganglion cell–inner plexiform layer
GPA	guided progression analysis
HFA	Humphrey field analyser
HR	hazard ratio
ICG	informal caregiver
IOP	intraocular pressure
MCSI	modified caregiver strain index
MGC	Müller glial cells
OCT	optical coherence tomography
OHT	ocular hypertension
OHTS	Ocular Hypertension Treatment Study
POAG	primary open-angle glaucoma
QoL	quality of life
RCTs	randomised control trials
RGC	retinal ganglion cell
RNFL	retinal nerve fibre layer
ROTA	retinal nerve fibre layer optical texture analysis
RR	Rate ratio
TrkB	tropomyosin-related kinase B
TUP	time until perceived
UK	United Kingdom
USD	United States dollar
VA OU	visual acuity oculus uterque
VFI	visual field index
VI	visual impairment
VR	virtual reality
wpm	words per minute

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