Acta Scientific Ophthalmology (ISSN: 2582-3191)

Volume 8 Issue 6 June 2025

Editorial

Advances in Glaucoma Management: A Multiparametric and Technological Approach

Isiaka Sanni Oluwasegun*

Department of Optometry and Vision Therapy, Albasar International Foundation: Makkah Specialist Hospital Bauchi, Nigeria

***Corresponding Author:** Isiaka Sanni Oluwasegun, Department of Optometry and Vision Therapy, Albasar International Foundation: Makkah Specialist Hospital Bauchi, Nigeria.

Received: April 28, 2025

Published: May 01, 2025

Glaucoma has been regarded as a global leading cause of irreversible blindness, and therefore, significant developments in glaucoma diagnosis, monitoring, and treatment have been anticipated [1,2]. An estimated 111 million people worldwide will be affected by glaucoma by 2040, making early detection and treatment strategies a priority [1]. Recent researches have added to the understanding of the disease by providing multiparametric histopathological grading, and investigating the use of nanorobots, self-monitoring tools and drugs made for this purpose [3-5]. These scientific advances hold the potential for improved accuracy and tailor-made treatment for patients with glaucoma.

Multiparametric grading of disease severity provides a significant step in advancing our understanding of glaucoma [3]; through post-mortem substratification pertaining to histopathological markers of severity, these have been correlated with both the progression of disease and responses to therapeutic intervention. Their findings highlight the importance of retinal ganglion cell (RGC) degeneration as a major hallmark of disease state, which could lead to the development of classification systems more closely aligned to clinical presentation that may ultimately feed into novel diagnostic criteria and treatment approaches.

Another landmark is the progress of selective inhibitors for key molecular targets in glaucoma. Xu, Pugh, and Blagg [6] investigated a class of broadly Grp94-selective and conformationally restricted inhibitors with potential to modulate endoplasmic reticulum stress, a contributor in glaucomatous neurodegeneration. Similarly, Bui., *et al*. [7] (2025) detected dual ROCK1/2 inhibitors from *Nocardiopsis* sp., that may facilitate the outflow of aqueous humor and decreases the level of intraocular pressure (IOP), the most important element in the control of glaucoma. Such results reaffirm the promise of targeted therapies in the management of glaucoma from both its IOP-linked and neuroprotective perspectives.

Nanotechnology is revolutionising ophthalmic therapy and nanorobotic applications offer alternative treatment options for the treatment of glaucoma. Ferreira., *et al*. [8] emphasized the use of nanorobots for achieving controlled drug delivery, enhancing patient adherence to treatment and reducing systematic side effects. These breakthroughs could drastically reshape glaucoma treatment, as they provide for prolonged, focused therapeutic responses.

In addition, home self-monitoring technologies are emerging, enabling patients to log their intraocular pressure from home. Quérat et Chen [5] investigated the feasibility and acceptability of the ICARE® HOME2 device, husbanded with a smartphone application. The study concluded that self-monitoring could be effective in managing disease, as it allows for early identification of pressure changes, which can be useful in progressive or unstable glaucoma patients.

Ongoing surgical innovations do continue to improve our outcomes in glaucoma [9], as Xu, Wang, and Wei compare modified penetrating deep sclerectomy to conventional trabeculectomy. Our results suggest that modified approaches may enhance safety and efficacy by marginalizing postoperative complications and preserving the benefices of pressure reduction.

On the neuroprotective front, Rodríguez-Ramírez., *et al*. [10] performed to investigate the protective role of estrogen receptor agonism in retinal ganglion cells. Their findings suggest that activation of beta estrogen receptors induces neuroprotection and thus represents a potential therapeutic target for neurodegeneration associated with glaucoma. This fits with a growing body of literature seeing neuroinflammation and microglial activation as key components of glaucomatous pathology [11].

Recent studies suggest that retinal vessel features play a role in disease progression in glaucoma. Freiberg., *et al*. Similar to our findings, [12] found longitudinal associations between vessel morphology with intraocular pressure and systemic blood pressure, indicating a potential interrelationship of vascular and ocular factors in disease progression. This underlines the importance of comprehensive patient evaluations, incorporating systemic health metrics into clinician decision-making for glaucoma care.

Moreover, color acuity assessment could be indicative of visual dysfunction in glaucoma. The Dyop Colors Test was studied recently by Sanni [13] to assess color acuity, showing that Dyop can be used to identify small shifts in visual function. The modality might be complementary to traditional visual field methods, providing an alternative metric to assess the impact of disease on the visual system.

Glaucoma management is undergoing a paradigm shift with advances in diverse fields like histopathology, pharmacology, nanotechnology and self-monitoring. The future of glaucoma management lies in a multiparametric approach, with emerging techniques like nanorobots and personalized medication providing further refinement in treatment strategies. With ongoing research effort shedding light on promising new treatment pathways, an integrative approach that bridges the clinical, technological, and molecular disciplines will be pivotal in combatting this sight-threatening disease.

Bibliography

1. Tham YC., *et al*. "Global prevalence of glaucoma and projections of glaucoma burden through 2040: A systematic review and meta-analysis". *Ophthalmology* 121.11 (2014): 2081-2090.

2. Quigley HA and Broman AT. "The number of people with glaucoma worldwide in 2010 and 2020". *The British Journal of Ophthalmology* 90.3 (2006): 262-267.

3. Xiang C., *et al*. "Multiparametric grading of glaucoma severity by histopathology can enable post-mortem substratification of disease state". *Acta Neuropathologica Communications* 13.1 (2025): 3.

4. Menezes Ferreira AÁ., *et al*. "Advancements and prospects in nanorobotic applications for ophthalmic therapy". *ACS Biomaterials Science and Engineering* 11.2 (2025): 958-980.

5. Quérat L and Chen E. "Self-monitoring of intraocular pressure with ICARE® HOME2 and a smartphone application: Feasibility and acceptability". *Acta Ophthalmologica* 103.1 (2025): 109-114.

6. Xu H., *et al*. "Conformationally restricted Grp94-selective inhibitors". *ACS Omega* 10.1 (2025): 449-455.

7. Bui TTM., *et al*. "Discovery of dual ROCK1/2 inhibitors from Nocardiopsis sp. under metal stress". *ACS Chemical Biology* 20.2 (2025): 432-441.

8. Ferreira AAM., *et al*. "Advancements and Prospects in Nanorobotic Applications for Ophthalmic Therapy". *ACS Biomaterials Science and Engineering* 11.2 (2015): 958-980.

9. Xu Z., *et al*. "Modified penetrating deep sclerectomy versus conventional trabeculectomy for the treatment of glaucoma: A 12-month randomized prospective study". *Acta Ophthalmologica* (2025).

10. Rodríguez-Ramírez KT., *et al*. "Neuroprotection of retinal ganglion cells by agonism of the beta but not the alpha estrogen receptor in the axotomized retina". *Acta Ophthalmologica* (2025).

11. Freiberg J., *et al*. "Longitudinal associations of retinal vessel morphology with intraocular pressure and blood pressure". *Acta Ophthalmologica* 103.1 (2025): 33-42.

12. Somerville MM., *et al*. "Role of microglia in glaucomatous pathology". *Advances in Experimental Medicine and Biology* 1468 (2025): 149-153.

13. Sanni Isiaka Oluwasegun and MC OD. "Use of Dyop Colors Test for Color Acuity Assessments. Visual Considerations in Managing the Dizzy Patient: A Case Series". (2023).