Editorial

Taiwan J Ophthalmol 2024;14:287-288

Access this article online

Quick Response Code:

Website:
http://journals.lww.com/TJOP

DOI:
10.4103/tjo.TJO-D-24-00081

Advancing glaucoma care with big data and artificial intelligence innovations

The capabilities of big data and artificial intelligence (AI) have advanced almost exponentially in the past few years, in large part through improvements in data availability (including from electronic health records [EHRs]) and the ability to analyze data rapidly and more precisely. Medicine has also seen the benefits of this evolution.

In many aspects, the field of glaucoma is ideally suited for the benefits demonstrated by AI due to its strong reliance on data, imaging, and other test results including visual fields. Furthermore, it is a chronic disease in which long-term data and repeated testing are typically available. Moreover, the challenges in establishing the glaucoma diagnosis and assessing its progression lend themselves well to assistance by AI, which has the potential to access large databases and the patient's own data history to better analyze and provide guidance for more optimal patient care.

AI methodologies including machine learning (ML) and deep learning (DL) models have greatly improved the analysis of large amounts of data. The DL approach exhibits the ability to make predictions based on multiple layers of artificial neural networks, providing more accurate results than the ML method.

Throughout this special issue, you will have the opportunity to get the latest update on the use of big data and AI technology in glaucoma management.

Visual Fields

Pham *et al.* described the advances in big data analytics for visual field testing, which have helped in evaluating the reliability, risk factors, structure–function relationship, early diagnosis, progression detection, clinical decision-making, and role in clinical trials related to visual fields.[1] The data from large databases have helped understand that shorter algorithms such as the Swedish Interactive thresholding algorithm (SITA) Faster may underestimate the degree of field loss. In addition, large datasets have shown that indeed, visual field progression is slow in the vast majority of patients, and the proportion of fast progressors (about 4%–5%) is relatively small. There are already existing studies that show AI models using ML and DL improve the detection of glaucoma and its progression.

The clinically relevant central field (central 5–10°) and its correlation with central/macular damage on optical coherence tomography (OCT) testing are explored by Du *et al.*[2] AI has shown advantages for the characterization and prediction of the patterns of progression in this important area of the patient's visual perception.

Role of Optic Nerve and Retinal Nerve Fiber Layer Imaging

In their article on AI in glaucoma management, Wu *et al.* described the roles of visual fields as well as optic nerve and retinal nerve fiber layer imaging, particularly OCT, in detecting and following glaucoma cases.[3] OCT can be especially key in the diagnosis of early glaucoma,

Submission: 15-07-2024
Accepted: 15-07-2024
Published: 13-09-2024

How to cite this article: Lin S. Advancing glaucoma care with big data and artificial intelligence innovations. Taiwan J Ophthalmol 2024;14:287-8.

and AI models have been shown to be very accurate at this early stage, although the clinical correlation is still important in verification and treatment planning. AI prediction and evaluation of glaucoma progression using OCT data is another strength of this technology. OCT angiography has also demonstrated the added benefit in neural models for the prediction of glaucoma and its advancement.

Similarly, Rodrigues da Casa *et al.* described the power of AI in OCT screening, diagnosis, and prediction of progression for glaucoma.[4] They also reviewed the effectiveness of AI systems that evaluate fundus photos for glaucoma screening. Furthermore, generative AI has been used for fundus photos and OCT, which can help in overcoming the challenges from poor image quality and the inherent differences between the devices.

Anterior Segment Imaging

Assessing whether an eye has or is at high risk for angle closure is an area that can also greatly benefit from AI guidance. In terms of anterior segment assessment, there is a significant variability and subjectivity with regard to the clinical examination, especially with gonioscopy. Anterior segment imaging (specifically, ultrasound biomicroscopy and anterior segment OCT) improves the objectivity of the assessment, but there are also interpretation issues with regard to the images from these technologies. Quantitative measures are available and are correlated with greater risk for angle closure; however, the myriad of parameters and their varying contributions make analysis very challenging when making the call of whether an eye has substantial risk for progression to glaucoma and should be treated. Furthermore, imaging can help distinguish subtypes of angle closure and response to treatment including surgeries. Chansangpetch *et al.* described the utility of big data and AI in making these assessments easier and quantitative for the clinician.[5]

Treatment

Big data can also help transform glaucoma treatment. Wu *et al.* detailed how big data and AI analyses assist at different stages of the evaluation of progression, determination for further therapy, and selection of optimal treatment methods for the patient.[6] The authors also described the role of genetic testing in risk stratification. How big data informs about the efficacy of surgical intervention and its probable outcomes in various scenarios and patient types may lead to the realization of precision medicine, especially with the guidance from AI.

Role in Research

Recently, the role of large datasets, including from EHRs, in research has expanded substantially to help answer important questions and guide therapeutic decisions. In many instances, big data – although retrospective in nature – can provide more real-world results than the "gold-standard" prospective, randomized clinical trial. Bernstein *et al.* described the wealth of data in ophthalmology and glaucoma from resources such as Intelligent Research in Sight, Sight Outcomes Research Collaborative, and All of Us Research Program.[7]

Conclusion

The concern that big data and AI will replace the doctor is likely not validated by the current technology or near-term developments. More likely, the assistance from big data and AI will enhance the glaucoma doctor's ability to better diagnose and monitor the disease.

At present, we are truly only at the advent of seeing the benefits of big data and AI. We can look forward to improvements in screening, diagnosis, and progression detection using data from clinical examination, imaging, and testing. Furthermore, treatment guidance will become more available. Our future will most likely include "personalized medicine" that takes into account many factors such as genetic information, demographic data, and clinical and test results.

Shan Lin*
Glaucoma Center of San Francisco, USA

***Address for correspondence:**
Dr. Shan Lin,
55 STEVENSON ST San Francisco, CA 94105.
E-mail: sl@glaucomasf.com

References

1. Pham AT, Pan AA, Yohannan J. Big data in visual field testing for glaucoma. Taiwan J Ophthalmol 2024;14:289-98.
2. Du KH, Kamalipour A, Moghimi S. Central visual field in glaucoma: An updated review. Taiwan J Ophthalmol 2024;14:360-70.
3. Wu JH, Lin S, Moghimi S. Application of artificial intelligence in glaucoma care: An updated review. Taiwan J Ophthalmol 2024;14:340-51.
4. da Costa DR, Medeiros FA. Big data for imaging assessment in glaucoma. Taiwan J Ophthalmol 2024;14:299-318.
5. Chansangpetch S, Ittarat M, Cheungpasitporn W, Lin SC. Artificial intelligence and big data integration in anterior segment imaging for glaucoma. Taiwan J Ophthalmol 2024;14:319-32.
6. Wu JH, Lin S, Moghimi S. Big data to guide glaucoma treatment. Taiwan J Ophthalmol 2024;14:333-39.
7. Bernstein IA, Fernandez KS, Stein JD, Pershing S, Wang S. Big data and electronic health records for glaucoma research. Taiwan J Ophthalmol 2024;14:352-59.