ARTIFICIAL INTELLIGENCE IN OPHTHALMOLOGY

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This is the era of Artificial intelligence (AI) and it is rapidly taking control of all spheres of life including medicine and healthcare. Ophthalmology is one of the departments of medicine that makes best use of cutting edge technologies. It is, therefore, no surprise that AI has shown tremendous potential to enhance the accuracy and efficiency of ophthalmic diagnostics, treatment, and research by employing advancements in software and computer based algorithms.[1]

One of the most significant applications of AI in ophthalmology is in the field of image analysis. Imaging techniques such as Optical Coherence Tomography (OCT) and fundus photography are routinely used in diagnosis, management, and follow up of disorders like diabetic retinopathy, age-related macular degeneration, and glaucoma. We can utilize AI algorithms to analyze these images and provide accurate and precise measurements of various parameters, such as thickness of different layers of retina, macular area, optic disc contours, and cup-to-disc ratio. This can help ophthalmologists not only in the early detection of eye diseases and enable timely interventions but also provide guidelines for prognosis and follow up.[2]

AI-based image analysis (especially in remotely managed telemedicine clinics) can also be used in the screening of large populations for eye diseases like cataract, diabetic retinopathy etc, especially in areas where there is a shortage of human resources. For instance, in a recent study conducted in Thailand regarding the feasibility of using AI algorithms to screen for diabetic retinopathy in a rural population, it was observed that AI had almost similar, if not better, reliability as trained human beings in the screening process.[3]

The use of AI in surgical planning and execution is also being explored. For example preoperative preparation of the patient for cataract surgery with the help of AI includes intraocular lens number estimation, incision site and even reduction of post-operative astigmatism. There are algorithms whereby surgeon eye movement can be detected and feedback on surgical technique be given at the end of surgery. This can greatly improve surgical technique and training.[4]

An indirect benefit to ophthalmology can be derived from AI-based Research & Development (R&D) in pharmaceutical industry. Using computer programs large datasets of gene expression, molecular interaction, and cellular pathways can be explored to identify target areas and interactions for existing and newer ophthalmic drug. Consequently better and safer drug molecules are expected to be discovered in future.[5]

Having said so much about the advantages of AI, let us talk about some of its shortcomings too that need to be addressed. One of the most important of the latter is the variable level of quality of data. Ophthalmic images can vary significantly in quality and resolution depending upon lighting conditions and equipment used. This can affect the comparative accuracy and precision of AI algorithms utilized to process these images.[6]

Like any new technology one major challenge is the validation and reliability of AI-based systems. As mentioned above, the performance of AI algorithms can vary depending on imaging equipment used, the population, and also

disease parameters like its incidence and prevalence. Large-scale, multicentric studies need to be undertaken to validate the performance of AI systems across different populations and settings. Lastly, regulatory bodies need to develop protocols and standards for AI use in ophthalmology as well as in all fields of medicine.[7]

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