Commentary: Deep learning in retinopathy of prematurity: Where do we stand?

Retinopathy of prematurity (ROP) is usually a disease of extremely premature babies. In developing nations like ours, improvement in neonatal care has led to survival of the premature babies, while inadequate ROP screening infrastructure has been unable to provide the care needed to all these premature babies, resulting in the third ROP epidemic.[1] In India, only about 1% of ophthalmologists are engaged in ROP care, creating an unmet need.[2] Telemedicine has been used to address this mismatch between the disease magnitude and care providers. Digital retinal images taken during telescreening have also opened the doors for objective, quantitative, and automated analysis of images using software innovations. In this article, the authors have presented one such way of quantitative analysis that can be used to predict the need for treatment in ROP.[3]

In recent years, deep learning (DL) has generated tremendous interest in various fields of medicine, particularly in evaluating fundus photographs in retinal diseases like diabetic retinopathy (DR), glaucoma, and age-related macular degeneration to predict the onset and progression of disease.[4] DL in ROP has been used to determine the presence or absence of pre-plus and plus disease (tortuosity and dilation),[5] need for treatment or referral,[6] and presence or absence of aggressive ROP.[7]

Use of DL with telescreening has a vast ability to reduce the cost and treatment burden of ROP. Software-based quantitative analysis allows for an objective assessment of the stage of ROP and may actually reduce screening errors, incorrect diagnosis, and inter-clinician variability and allow early treatment. Also, ROP is a time-dependent disease that rapidly progresses if not treated adequately on time. Use of these DL tools can help triage the images and babies needing urgent bedside examination and treatment. It also allows ease of discussion among physicians and experts, enabling better learning as well as treatment for babies. Enhanced information provided by these tools may lead to better understanding and increased treatment window and may pave way for better preventive medical interventions to prevent the progression of disease.

Most of these algorithms in a clinical trial setting with good-quality images have been reported to have a sensitivity of 97%–100% and specificity of 64%–93%.[5,8,9] The Stanford University Network for Diagnosis of Retinopathy of Prematurity (SUNDROP) trial found that telemedicine had 100% sensitivity, 99.8% specificity, 93.8% positive predictive value, and 100% negative predictive value for detection of treatment-warranted ROP.[9] Multiple good-quality images are necessary to achieve these results. Low specificity indicates an increase in false positives, and therefore an unnecessary need for validation by an expert ROP/pediatric ophthalmologist with its inherent cost and time burden. On the other hand, high sensitivity means high detection rates, which is most desirable in diseases like ROP where the implications of not treating a baby under regular care of a physician are huge both for the patient as well as the treating physician. Though in DL-based programs, telescreening is done by a non-physician trained technician and the need for treatment is judged by a software, the responsibility for preventing blindness from ROP will rest with the treating physician unless modification of law after due validation of these newer techniques is done by the regulatory body for medicolegal issues. Also, whether these software programs will pick up any associated incidental findings seen sometimes in these babies or differentiate them from other retinal dysplasias remains to be seen.

Though future implications of DL in ROP are promising, further large-scale studies will be necessary in different ethnicities and races to determine and improve the diagnostic ability, so that not even a single baby becomes blind due to lack of treatment. Financial burden of acquiring the highly expensive cameras that can provide good digital images is a major roadblock for the widespread implementation of DL in a developing nation like India.

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