Prediction of Visual Acuity Improvement in Response to Ranibizumab in Age-Related Macular Degeneration Using Artificial Intelligence-Based Analysis of Fluorescein Angiography

Ryan S. Huang[1], MSc MD(C), Andrew Mihalache[1], MD(C), Marko M. Popovic[2], MD MPH,
David T. Wong[2], MD FRCSC, Rajeev H. Muni[2], MD MSc FRCSC,

[1]Temerty Faculty of Medicine, University of Toronto
[2]Deptartment of Ophthalmology and Vision Science, University of Toronto

Introduction: To elicit whether baseline quantitative vascular parameters derived from intravenous fluorescein angiography can predict improvement in best-corrected visual acuity (BCVA) in response to ranibizumab in patients with neovascular age-related macular degeneration (nAMD).

Methods: A prospective cohort study was conducted at a single center in Toronto, Canada from 2017 to 2023, involving patients over 50 years with a diagnosis of active choroidal neovascularization secondary to AMD. At baseline, patients were imaged with fluorescein angiography using an ultra-widefield scanning laser ophthalmoscope. Images were processed using the artificial intelligence RETICAD system to extract quantitative retinal vascular parameters, including blood-retinal-barrier (BRB) permeability, perfusion, and blood flow. All nAMD patients were treated using a pro re nata regimen of ranibizumab and final outcomes were measured at 12 months of follow up. Associations between quantitative retinal vascular parameters with functional and anatomical outcomes were examined using univariable and multivariable regression models. Receiver-operating characteristic (ROC) curves and area-under-the-curve (AUC) values were used to determine the predictive value of fluorescein angiography parameters for BCVA improvement following treatment.

Results: The study population included 60 eyes from 60 patients with confirmed nAMD. Among patients with nAMD, most were female (n=37, 61.7%), Caucasian (n=44, 73.3%), and had a mean age of 80.8 ± 8.0 years. On multivariable analysis, baseline central BRB permeability was associated with the change in BCVA from baseline to 12 months (p=0.034), and the number of ranibizumab injections over 12 months (p=0.003). Patients with improved BCVA had significantly lower baseline values of central (p=0.003) and peripheral (p=0.007) BRB permeability compared to those with no improvement. ROC analysis revealed central and peripheral BRB permeability were strong predictors of BCVA improvement (AUC=0.85).

Conclusion: Baseline quantitative fluorescein angiography parameters, particularly BRB permeability, were predictive of BCVA improvement following ranibizumab treatment. Future work should explore associations between quantitative fluorescein angiography parameters and functional and anatomical outcomes in diverse nAMD patient populations.