Machine Learning Quantification of Fluid Volume in Eyes with Retinal Vein Occlusion Undergoing Treatment with Aflibercept: The REVOLT study

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METHODS

49 treatment-naive subject eyes were diagnosed with visual impairment due to RVOs, either central (CRVO) or branch (BRVO). SS-OCT data was used to assess retinal layer thicknesses, as well as quantify intraretinal fluid (IRF), subretinal fluid (SRF), and serous pigment epithelium detachments (PEDs) using a deep learning-based, macular fluid segmentation algorithm (Figure 1). Patients received 3 loading doses of 2 mg intravitreal aflibercept injections (IAI). Image analysis was performed at baseline, month 3 & month 6 follow-up. Baseline OCT morphological features and fluid measurements were correlated using the Pearson correlation coefficient (PCC) to changes in BCVA to determine which features most impacted 6-month change in BCVA. The area of non-perfusion in OCT-A images treated would also be evaluated through ischemic index computation (Figure 2).

RESULTS

A combined model of thickness in the Outer Plexiform Layer (OPL), retinal nerve fiber layer (RNFL) and presence of IRF had the strongest overall correlation for CRVO (PCC=0.865, p <0.05); while for BRVO the addition of IRF to the OPL-Inner Nasal model had a strong correlation (PCC=0.803, p<0.05). Baseline Ischemic Index in the Deep Capillary Complex (DCP) for CRVO without denoising demonstrated notable correlation with 6-month change in BCVA (PCC=0.9101, p < 0.05).

CONCLUSION

A combined model of IRF and thickness, alongside ischemic indices provide the best correlation to BCVA changes. This is clinically consistent given that the DCP supplies the OPL, as macular fluid builds up, these vessels have reduced flexibility to accommodate; thus becoming more occluded, causing further damage to the OPL. Ultimately, an AI approach to analyzing fluid metrics may provide an advantage in personalizing therapy and predicting BCVA outcomes for RVO patients.

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