Utilisation of Machine Learning to Quantify Fluid Volume of Neovascular Age-Related Macular Degeneration (nAMD) Patients Based on Swept-Source Optical Coherence Tomography (SS-OCT): Imaging the ONTARIO Study

Simrat K. Sodhi, M.Sc.;^1 Jonathan D. Oakley, Ph.D.;^2 Austin Pereira, M.D., M.Eng.;^4 Daniel B. Russakoff, Ph.D.^2 and Netan Choudhry, M.D., FRCSC^3,^4,^5

^1 University of Cambridge, Cambridge, UK; ^2 Voxeleron LLC, San Francisco, USA; ^3 Vitreous Retina Macula Specialists of Toronto, Etobicoke, ON, Canada; ^4 Department of Ophthalmology & Visual Sciences, University of Toronto, Toronto, ON Canada; ^5 Cleveland Clinic Canada, Toronto, ON, Canada

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PURPOSE
Evaluate the predictive ability of a deep learning-based, automated, macular fluid segmentation algorithm to determine long-term visual acuity (VA) outcomes in neovascular age-related macular degeneration (nAMD) patients using baseline swept-source optical coherence tomography (SS-OCT) and OCT-angiography (OCT-A) data.

METHODS
Twenty-two SS-OCT volumes of the macula, comprising 5,632 images from 22 nAMD subjects were used to assess retinal layer thicknesses, quantify intraretinal fluid (IRF), subretinal fluid (SRF) and fluid in serous pigment epithelium detachments (PED). Layer thicknesses were manually corrected and fluid segmentation was performed using a novel, deep learning algorithm with results validated relative to two expert graders (Fig 1). Seventeen treatment-naive subject eyes, from the previously reported CANADA study, were enrolled in this study. OCT-A data was used to manually define the extent of the choroidal neovascularization (CNV) in each scan (Fig 2). Baseline OCT morphological features and measurements were correlated using the Pearson correlation coefficient (PCC) to changes in VA to determine which features impacted the long-term visual outcomes.

RESULTS

Total retinal fluid (IRF, SRF and PED) volume at baseline had the closest correlation to improvement in BCVA at month 12 (PCC=0.652, p=0.009) (Fig 3). Fluid was subsequently sub-categorized into IRF, SRF and PED, with PED volume having the highest correlation (PCC=0.648, p=0.005) to BCVA improvement. Average total retinal thickness in isolation provided a lower correlation, and average total retinal thickness in combination with lesion size may provide an advantage in personalizing therapy and predicting BCVA outcomes.

CONCLUSION
In isolation, total fluid volume best correlates with change in BCVA values between baseline and week 52. In combination with complimentary information from OCT-A, an improvement in the linear correlation score was observed. Average total retinal thickness provided a lower correlation, and thus provides a lower predictive outcome than alternative metrics assessed. In this pilot study, SS-OCT and OCT-A data together correlated better to visual acuity outcomes then any one metric in isolation. Clinically, a machine-learning approach to analyzing fluid metrics in combination with lesion size may provide an advantage in personalizing therapy and predicting BCVA outcomes.

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For any questions or comments, contact simrat.k.sodhi@gmail.com