ORAL PRESENTATIONS

Retinal blood vessel analysis using optical coherence tomography in multiple sclerosis

Nicholas Young,[1] Robert Zivadinov,[1,2] Michael G Dwyer,[1] Niels Bergsland,[1,3] Bianca Weinstock-Guttman,[4] Dejan Jakimovski[1]

[1]Buffalo Neuroimaging Analysis Center (BNAC), Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, State University of New York, Buffalo, USA; [2]Center for Biomedical Imaging at Clinical Translational Science Institute, University at Buffalo, State University of New York, Buffalo, USA; [3]IRCCS, Fondazione Don Carlo Gnocchi ONLUS, Milan, Italy; [4]Jacobs Comprehensive MS Treatment and Research Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences University at Buffalo, Buffalo, USA

Background

Both greater retinal neurodegenerative pathology and greater cardiovascular burden have been seen in persons with multiple sclerosis (pwMS).[1,2] Moreover, studies have described multiple extracranial and intracranial vasculature changes in pwMS.[3] However, only a few studies have examined the retinal vasculature in multiple sclerosis (MS).

Objectives

To determine if there are differences in retinal vasculature between pwMS and healthy controls (HCs) and their relationship to peripapillary retinal nerve fiber layer (pRNFL) thickness.

Materials and methods

A total of 167 pwMS (113 relapsing-remitting MS (RRMS) and 54 progressive MS (PMS)) and 48 HCs were scanned using optical coherence tomography (OCT). Earlier OCT scans were available in a smaller sample size of 101 pwMS and 35 HCs for additional longitudinal 5-year follow-up analysis. The semiautomated segmentation of the retinal vasculature was performed in a blinded manner on peripapillary scans using the optical coherence tomography segmentation and evaluation GUI (OCTSEG) in MatLab. (Figure 1). Automated segmentation of the pRNFL was performed in the native Heidelberg OCT software. The sum of bilateral measures of total retinal vessel diameter, the total number of retinal vessels and average vessel diameter were calculated. Independent sample t-test and paired t-test were used for cross-sectional and longitudinal analyses, respectively and non-parametric Spearman's test for determining correlations.

Correspondence: Dejan Jakimovski, Research Assistant Professor, Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences University at Buffalo, State University of New York, 100 High Street, Buffalo, 14203, USA.
E-mail: djakimovski@bnac.net
Tel. 716-859-7040 - Fax. 716-859-7066.

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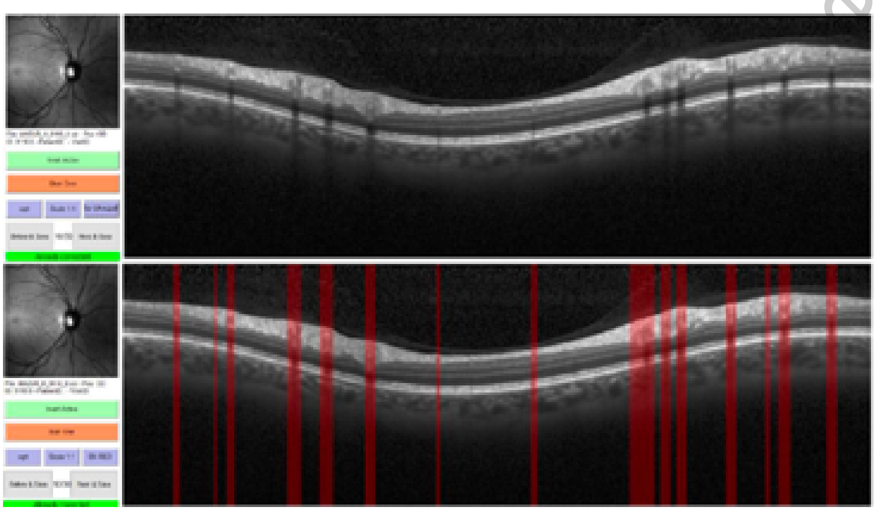

Figure 1. Semiautomated blood vessel segmentation of peripapillary retinal images acquired using optical coherence tomography (OCT). The top panel demonstrates the peripapillary retina with all retinal layers and blood vessels displayed in the Optical Coherence Tomography Segmentation and Evaluation GUI (OCTSEG). The vessels in the bottom panel are segmented based on the anatomical feature of vessels within the retinal layer and shadows through the retinal layers.

Results

PwMS had a significantly smaller total vessel diameter (2.5 cm *vs* 2.7 cm, age-adjusted p=0.017) and numerically fewer number of retinal vessels when compared to HCs (35.1 *vs* 36.8, age-adjusted p=0.167). No significant differences between the pwRRMS and pwPMS were found. Over the follow-up, pwMS had significant decrease in number of retinal vessels (36.7 vs. 33.0, p<0.001) and significant increase in the average vessel diameter (0.072cm vs. 0.081cm, p<0.001). No longitudinal changes in the HCs were noted. Only in pwMS, lower pRNFL was associated with fewer retinal vessels and total vessel diameter (r=0.191, p=0.018 and r=0.216, p=0.007).

Conclusions

PwMS have retinal vasculature that results in smaller and fewer retinal vessels when compared to HCs that were related to reduced pRNFL. Over time, a reduction of retinal vasculature occurred. Future investigations should determine the relevance of retinal vasculature in regards to MS disease outcomes, presence of cardiovascular abnormalities and cerebral/retinal perfusion.

References

1. Jakimovski D, Topolski M, Genovese AV, et al. Vascular aspects of multiple sclerosis: emphasis on perfusion and cardiovascular comorbidities. Expert Rev Neurother 2019;19:445-458.
2. Jakimovski D, Zivadinov R, Vaughn CB, et al. Clinical effects associated with five-year retinal nerve fiber layer thinning in multiple sclerosis. J Neurol Sci 2021;427:117552.
3. Belov P, Jakimovski D, Krawiecki J, et al. Lower Arterial Cross-Sectional Area of Carotid and Vertebral Arteries and Higher Frequency of Secondary Neck Vessels Are Associated with Multiple Sclerosis. AJNR Am J Neuroradiol 2018;39:123-130.