Impaired Layer Specific Retinal Vascular Reactivity Among Diabetic Subjects

Amir H Kashani, MD, PhD
Pasadena, CA

Maxwell Singer, BS, Bright S Ashimatey, PhD, Xiao Zhao, BS, Zhongdi Chu, MS, Ruikang Wang, PhD

Purpose:
To investigate layer specific retinal vascular reactivity (RVR) in capillaries of diabetic subjects with no or mild non-proliferative diabetic retinopathy (NPDR).

Methods:
A previously described nonrebreathing apparatus (Ashimatey BS et al., IOVS 2019; Kushner-Lenhoff S et al., J Vis Exp 2020) was used to deliver room air, 5% CO₂, or 100% O₂ to 41 controls and 22 diabetic subjects (with mild or no NPDR) while simultaneously acquiring fovea-centered 3x3mm² Swept-Source Optical Coherence Tomography Angiography. Vessel skeleton density (VSD) and vessel diameter index (VDI) were calculated for each gas condition for the superficial retinal layer (SRL) and deep retinal layer (DRL). The superficial layer analysis excluded regions of arterioles and venules. Data analysis was performed using mixed factorial analysis of covariance stratified by diabetic status. All models were adjusted for age, gender, and hypertension.

Results:
Among controls, there was a significant difference in capillary VSD between all gas conditions (p<0.001). This difference was present in both the SRL and DRL. Among diabetics, there was no significant difference in response to CO₂ conditions in the SRL (p=0.072), and a blunted response to both CO₂ and O₂ in the DRL. A significant gas effect was detected in the capillary VDI in the SRL of controls (p=0.001), which was driven by higher VDI in the oxygen condition compared to that of carbon dioxide.

Conclusions:
Impairment in RVR in diabetic subjects is driven largely by a decrease in the magnitude of the capillary response to O₂ in the DRL as well as almost complete attenuation of capillary CO₂ response in all layers. These layer and gas specific impairments in diabetics seem to occur early in the disease and to be driven primarily at the capillary level.