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MEETING ABSTRACT

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A novel approach for measurement of retinal oxygen extraction based on laser speckle flowgraphy and retinal oximetry

Viktoria PAI¹, Patrick JANKU¹, Theresa LINDNER¹, Liudmyla PYLYPENKO¹, Anton HOMMER^{1,2}, Leopold SCHMETTERER^{1,3,4,5,6,7,8}, Gerhard GARHÖFER^{1,*}, Doreen SCHMIDL¹

¹Department of Clinical Pharmacology, Medical University of Vienna, Austria; ²Ordination Dr. Hommer, Vienna, Austria; ³Singapore Eye Research Institute, Singapore National Eye Centre, Singapore; ⁴Ophthalmology and Visual Sciences Academic Clinical Program, Duke-NUS Medical School, Singapore; ⁵SERI-NTU Advanced Ocular Engineering (STANCE), Singapore, Singapore; ⁶School of Chemistry, Chemical Engineering and Biotechnology, Nanyang Technological University, Singapore; ⁷Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Austria; ⁸Institute of Molecular and Clinical Ophthalmology, Basel, Switzerland

Background: Retinal oxygen saturation difference between arteries and veins is altered in several ocular and systemic diseases. A reduction in arteriovenous oxygen difference suggests a reduction in retinal oxygen extraction. However, this can only be confirmed by taking retinal blood flow into account. Measurement techniques for the assessment of retinal oxygen extraction are highly warranted but are limited because most of them are time-consuming and they are usually based on experimental setups. Hence, the aim of this study is to assess retinal oxygen extraction based on measurement of retinal blood flow with the commercially available laser speckle flowgraphy and measurement of retinal oxygen saturation with the commercially available retinal oximetry.

Methods: Ten young healthy subjects participated in the present study. In each vessel around the optic disc retinal blood flow and retinal oxygen saturation were measured at the same position. The corrected arterial ($cO_{2,CRA}$) and venous ($cO_{2,CRV}$) oxygen content was estimated from the parameters evaluated and the difference between these two determined parameters ($cO_{2,DIFF}$) was assessed. Retinal oxygen extraction was calculated using mean vessel flow rate (Q_{MV}) and $cO_{2,DIFF}$. It is known that retinal oxygen saturation decreases during systemic hyperoxia. Therefore, this novel approach for measurement of retinal oxygen extraction was validated by a baseline measurement and a measurement during inhalation of 100% oxygen.

Results: Q_{MV} significantly decreased during 100% oxygen breathing ($-23 \pm 10\%$, $p < 0.001$). While $cO_{2,CRA}$ only slightly increased by $1 \pm 2\%$ ($p = 0.093$), $cO_{2,CRV}$ increased by $9 \pm 14\%$ ($p = 0.050$). Consequently, $cO_{2,DIFF}$ decreased by $10 \pm 20\%$ ($p = 0.087$). This led to a pronounced decrease in retinal oxygen extraction by $-31 \pm 18\%$ during hyperoxia ($p < 0.001$).

Discussion: During systemic hyperoxia, induced by breathing 100% oxygen, a significant decrease in total retinal blood flow and retinal oxygen extraction was observed, which is consistent with previous findings in the literature and physiologically expected. Therefore, the presented approach for measurement of retinal oxygen extraction using commercially available devices appears to be feasible. Studies using this method in larger patient cohorts should be conducted in the future.

Keywords: laser speckle flowgraphy – retinal oxygen extraction – hyperoxia

*Corresponding author e-mail: gerhard.garhoefer@meduniwien.ac.at