Retinal Oximetry with a Scanning Laser Ophthalmoscope

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Purpose

To test the sensitivity of a scanning laser ophthalmoscope (SLO) for measurements of hemoglobin oxygen saturation in retinal blood vessels.

Methods

Figure 1. A scanning laser ophthalmoscope (SLO), Optomap 200Tx (Optos plc., Dunfermline, Scotland, UK).

Results

Two different methods were used to investigate the sensitivity of the device: (1) inhalation of 100% oxygen and (2) measurements of patients with confirmed venular hypoxia (central retinal vein occlusion, CRVO).

1. Hyperoxia: Inhalation of 100% oxygen

Two healthy subjects inhaled 100% oxygen for 10 minutes (10L/min). Fundus images were acquired before inhalation (baseline), when inhalation ended (time=0), every 5 seconds for 135 seconds during recovery and after 10 min of recovery (time=10 min).

Figure 2. The SLO uses two wavelengths for image acquisition, 532 and 633 nm. Oxymap Analyzer software (Oxymap ehf., Reykjavík, Iceland), analyzes the images and calculates oxygen saturation in the retinal vessels.

Figure 3. Oximetry fundus images from one healthy subject.

Figure 4. Oxygen saturation over time for arterioles and venules for two healthy subjects (A and B). Subjects inhaled pure oxygen for 10 minutes (10L/ min) and fundus images were acquired when the inhalation ended (time=0) and every 5 seconds for 135 seconds during recovery.

2. Hypoxia: CRVO

Oxygen saturation was measured for retinal arterioles and venules for three patients with CRVO and one with hemi-vein occlusion. The mean venular oxygen saturation was 23% ± 3% (mean ± SD) for the affected eye and 59% ± 3% for the healthy fellow eye.

Figure 5. Oximetry fundus image from one subject with CRVO. (CRVO affected eye to the right, healthy fellow eye to the left).

Conclusions

Scanning laser ophthalmoscope oximetry is sensitive to changes in retinal oxygen saturation. It detects retinal hypoxia in CRVO.

Further technical development and clinical testing is needed for optimization of SLO oximetry.