

Purpose

Earlier studies on animals have indicated that oxygen tension in the inner retina is lower in light than in dark (Linsemeier, Braun 1992), whereas the oxygen consumption in the retina as a whole is lower in light (Stefansson et al 1983, 1988). The purpose of the study was to measure the hemoglobin oxygen saturation (SatO₂) in retinal vessels after periods of dark and light in human subjects.

Methods

Our automatic oximeter non-invasively yields fundus images with 4 wavelengths of light simultaneously.

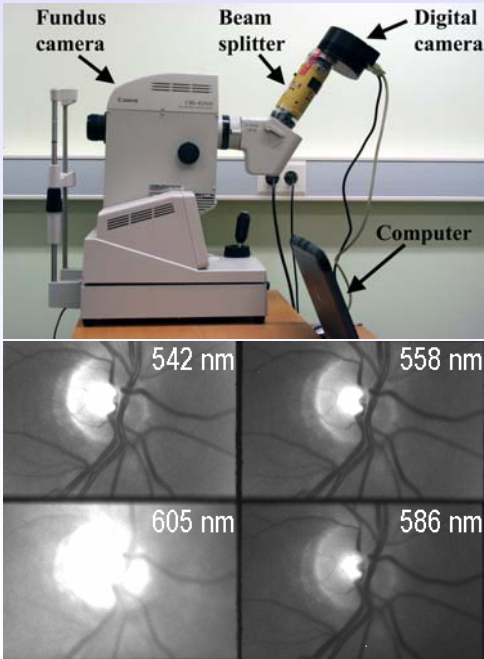


Figure 1. The retinal oximeter. Above: Components. Below: A typical output.

Specialized software automatically selects points on vessels and adjacent fundus for calculation of optical density ratios (ODRs). ODRs have an approximately linear inverse relationship with hemoglobin oxygen saturation (SatO₂) (Beach JM et al. 1999).

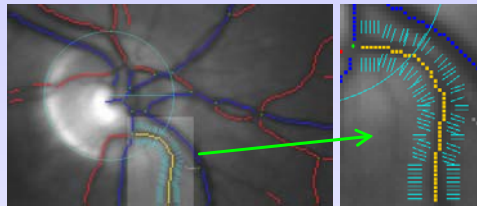


Figure 2. Automatic selection of measurement points.

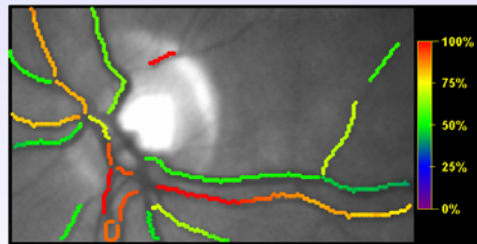


Figure 3. An example of a color-coded map of hemoglobin oxygen saturation. The map is generated automatically by the oximeter. This patient had diabetes but no retinopathy.

We performed oximetry in 17 healthy volunteers. First degree arterioles and venules were measured in one eye of each subject. The subjects were first placed in the dark for 30 minutes, then alternatingly in light and dark; each light or dark period lasting for 5 minutes. Oximetry was performed at the end of each period. Altogether, 6 measurements were made on each individual. The room light was approximately 80cd/m². Statistical analysis was done by paired t-tests.

Results

The figures below summarize the results for arterioles (fig. 4), venules (fig. 5) and arteriovenous difference (fig. 6).

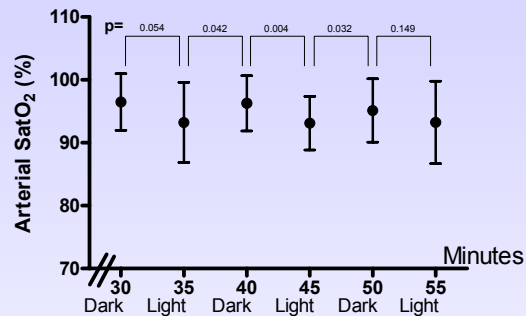


Figure 4. Retinal arterial saturation after 30 min. of dark adaptation and after 5 subsequent periods of either room light or dark. The graph shows means and SD.

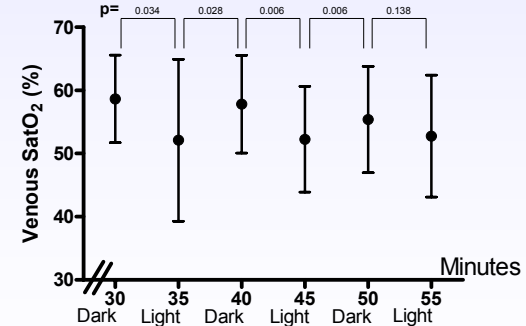


Figure 5. Retinal venous saturation after 30 min. of dark adaptation and after 5 subsequent periods of either room light or dark. The graph shows means and SD.

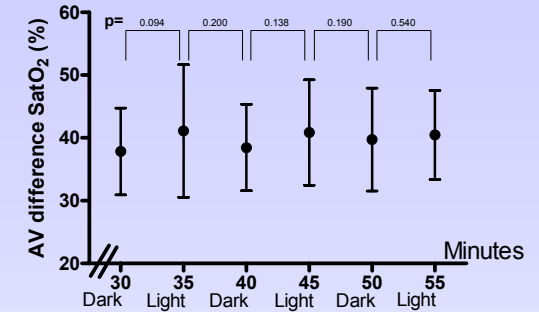


Figure 6. Retinal arteriovenous difference in saturation after 30 min. of dark adaptation and after 5 subsequent periods of either room light or dark. The graph shows means and SD.

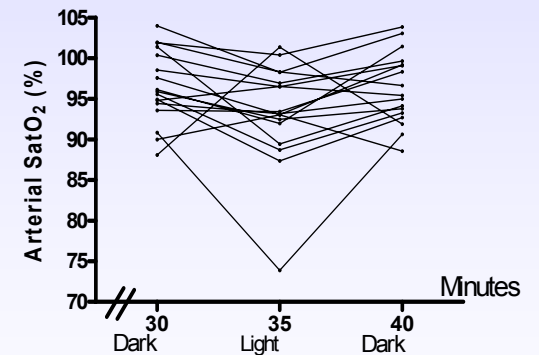


Figure 7. Raw data from first three measurements on arterioles. Each line connects measurements from one individual.

Conclusions

These results suggest that the hemoglobin oxygen saturation is lower in both retinal arterioles and venules when the retina is in light compared to when it is in dark.

Commercial relationship: S. Basit, None; S.H. Hardarson, Oxymap ehf., I. Oxymap ehf., P.; G.H. Halldorsson, Oxymap ehf., I. Oxymap ehf., E. Oxymap ehf., P.; R.A. Karlsson, Oxymap ehf., I. Oxymap ehf., E. Oxymap ehf., P.; J.M. Beach, Oxymap ehf., I. Oxymap ehf., P.; T. Eysteinnsson, Oxymap ehf., I. Oxymap ehf., P.; J.A. Benediktsson, Oxymap ehf., I. Oxymap ehf., P.; A. Harris, Oxymap ehf., I. E. Stefansson, Oxymap ehf., I. Oxymap ehf., P.

Support: Icelandic Research Council, Icelandic Fund for Prevention of Blindness, University of Iceland Research Fund, Landspítali - University Hospital Research Fund.