Increased oxygen saturation in retinal vessels of patients with retinopathy requiring treatment

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Introduction:

Diabetic retinopathy is characterized by hyperperfusion in the macular area leading to diabetic maculopathy, and hypoperfusion in the retinal periphery leading to proliferative diabetic retinopathy (figures 1 & 2). These changes can be expected to influence retinal oxygenation.

The purpose of the present study was to study the consequences of perfusion changes on retinal metabolism by assessing retinal oxygenation in diabetic patients with increasing retinopathy grade.

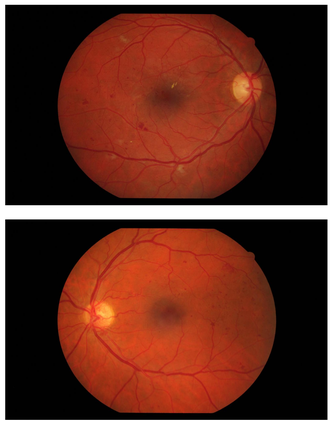

Figure 1. Diabetic maculopathy as evidenced by hard exudates in the macular area.

Figure 2. Proliferative diabetic retinopathy with new vessels at the optic disk.

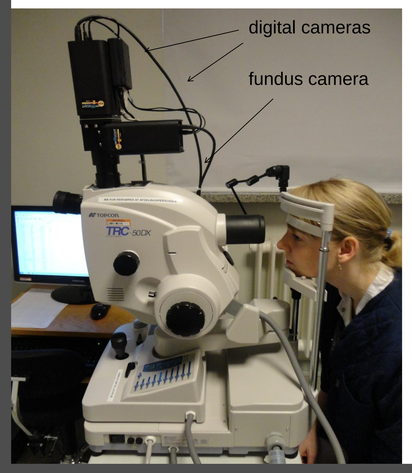

Figure 3. The retinal oximeter consists of a fundus camera and two digital cameras that record images at 600 nm and at 570 nm. Specialized software calculates the oxygen saturation based on the difference in light absorbance betweeen the two wavelengths.

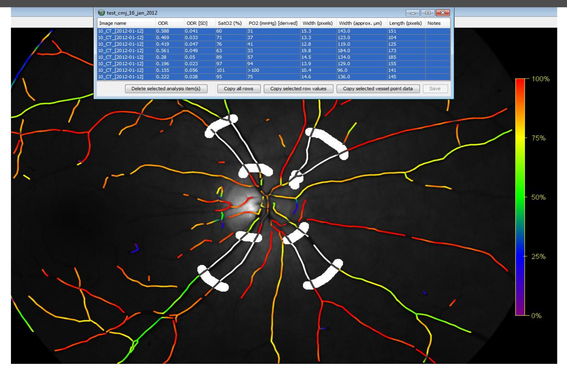

Figure 4. Color map of the oxygen tension in retinal vessels from a normal person. The white lines delineate the vascular segments included in the analysis.

Methods:

A noninvasive spectrophotometric retinal oximeter (Oxymap, version 2.2.1) was used to measure oxygen saturation in retinal arterioles and venules (figures 3 & 4).

184 consecutive patients with diabetes mellitus (50 with T1D and 134 with T2D), referred for specialist evaluation, were subjected to a routine clinical examination, including fundus inspection and oximetry. 37 normal persons were included as reference. The relative oxygen saturation in an arteriole and its adjoining venule within one disk diameter from the optic disk were compared between 32 patients who were diagnosed with proliferative diabetic retinopathy, 45 patients who were diagnosed with diabetic retinopathy requiring treatment, 98 patients who were diagnosed with retinopathy not requiring treatment, 9 patients who were diagnosed with diabetes mellitus without diabetic retinopathy and 37 normal persons without diabetes mellitus.

Oxygen saturation between the groups was compared by Kruskal-Wallis test, followed by Mann-Whitney U test on combinations of two among the groups.

Results:

Oxygen saturation in both retinal arterioles and venules was independent of age and diabetes duration.

Figure 5A shows that there was no significant difference in the oxygen saturation among the five groups .

Figure 5B shows that the oxygen saturation in retinal venules was significantly higher in diabetic patients with retinopathy than in normal persons and in diabetic patients with no retinopathy. Additionally, the oxygen saturation was significantly higher in patients with retinopathy requiring treatment than in patients with retinopathy not requiring treatment.

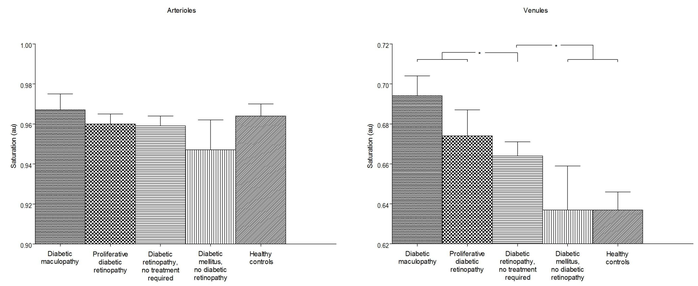

Figure 5. Oxygen saturation (mean±SEM) in A) arterioles and B) venules in the five studied groups.

Conclusions:

Diabetic retinopathy is accompanied with unchanged oxygen tension in retinal arterioles but increased oxygen tension in retinal venules which may be due to reduced oxygen extraction due to hyperperfusion or disturbances in retinal metabolism. An elucidation of the background for these changes may contribute to a further understanding of diabetic retinopathy.

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