# 5366 Retinal Oxygenation After Laser Photocoagulation in Patients with Proliferative Diabetic Retinopathy

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## Purpose

Capillary non-perfusion and shunting of blood through preferential channels in the capillary network are cardinal features of diabetic retinopathy [1]. Shunting disturbs delivery of oxygen to the retina. The purpose of this study is to measure oxygen saturation in retinal blood vessels in patients with diabetic retinopathy (DR).

## Methods

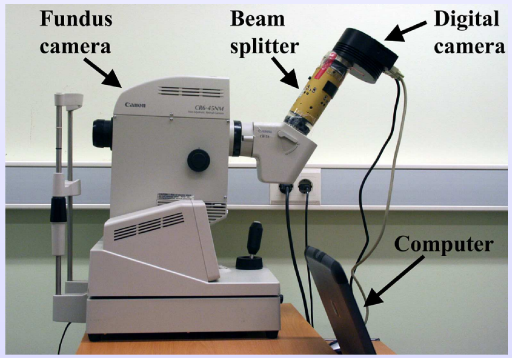


*Figure 1. The retinal oximeter*

Our automatic retinal oximeter [2] is based on a fundus camera. It yields fundus images with 4 wavelengths of light simultaneously. Two wavelengths, 605nm and 586nm, are used for calculation of oxygen saturation. Specialized software automatically selects measurement points on the oximetry fundus images and estimates the oxygen saturation in retinal vessels.

Oximetry was performed in 1st and 2nd degree temporal retinal vessels in healthy individuals, patients with non-proliferative DR (NPDR) and patients with proliferative DR (PDR) and a history of panretinal photocoagulation (PRP), see table 1.

One eye was measured in each individual. One-way ANOVA and Tukey's post tests were used to compare all three groups.

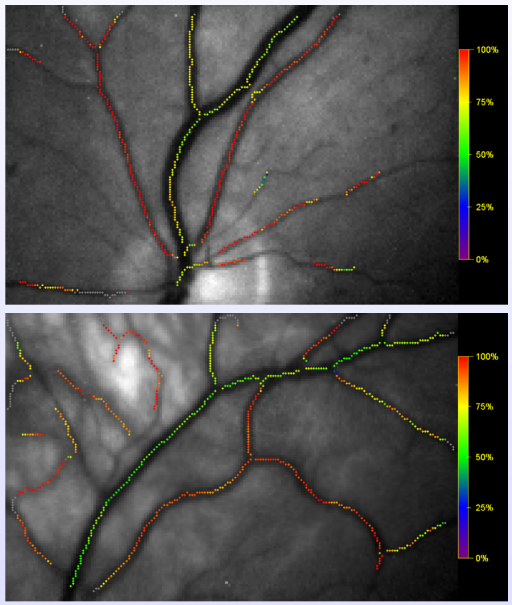


*Figure 2. Pseudocolor maps of two fundi, showing oxygen saturation in retinal vessels. Above: A patient with macular edema and background DR. Below: A healthy volunteer.*

*Table 1. The groups studied*

| | |
|---|---|
| Healthy volunteers, n=20 | |
| Age | 28±8 years (mean±SD) |
| Gender | 14 males, 6 females |
| Patients with NPDR, no history of treatment for DR, n=12 | |
| Age | 49±17 years (mean±SD) |
| Gender | 9 males, 3 females |
| No. with type of diabetes | 6 type I, 6 type II |
| Duration of diabetes | 20±7 years (mean±SD) |
| Patients with PDR, successfully treated with PRP, n=9 | |
| Age | 38±13 years (mean±SD) |
| Gender | 8 males, 1 female |
| No. with type of diabetes | 9 type I, 0 type II |
| Duration of diabetes | 23±5 years (mean±SD) |

## Results

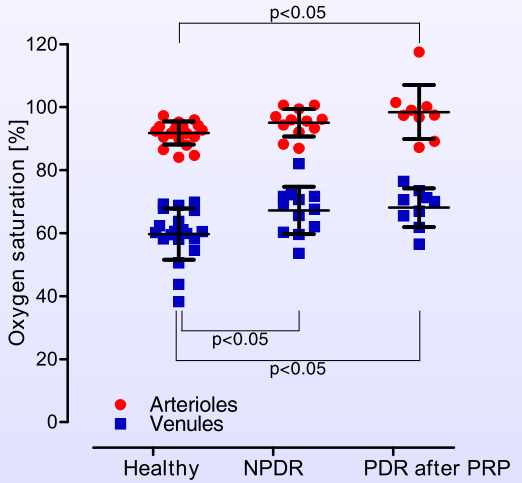


*Figure 3. Oxygen saturation (%) in 1st and 2nd degree arterioles and venules. Each point denotes a measurement from one eye, bars denote means and SDs.*

Table 2 shows results from the same measurements as fig. 3.

*Table 2. %Oxygen saturation. Means±SD.*

| | Healthy N=20 | NPDR N=12 | PDR After PRP N=9 |
|---|---|---|---|
| Arterioles | 92±4% | 95±5% | 98±9% |
| Venules | 60±8% | 67±7% | 68±6% |
| AV difference | 32±8% | 28±8% | 30±8% |

For statistical significance, see fig. 3. Arteriovenous difference was not significantly different between the three groups.

## Discussion

Our results show that patients with PDR, who have had laser treatment, and patients with untreated NPDR, have higher retinal venous oxygen saturation than healthy volunteers.

This is consistent with shunting of blood from arterioles to venules through preferential channels in the capillary network [1]. Parts of the retinal tissue may be hypoxic due to capillary occlusion. At the same time, the increased blood flow through the preferential channels results in decreased oxygen loss from blood. Consequently, venous oxygen saturation is increased.

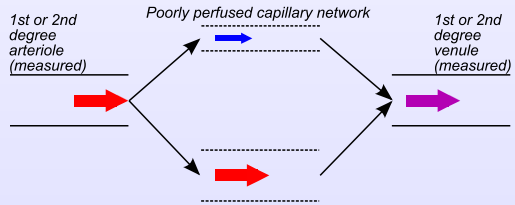


*Figure 4. The measured retinal venules in the diabetic patients drain both poorly perfused parts of the capillary network and preferential channels. The poorly perfused tissue will be hypoxic while the shunting will raise the measured saturation in the venules.*

An alternative explanation of our results could be decreased oxygen consumption of the diabetic retina with inadequate vascular compensation. Furthermore, in the PRP treated group, the treatment may have decreased oxygen extraction from arterioles and capillaries.

## Conclusions

Increased venous oxygen saturation is consistent with shunting in the microcirculation and tissue hypoxia in diabetic retinopathy.

## References

1. Cogan, D.G., D. Toussaint, et al. (1961). "Retinal vascular patterns. IV. Diabetic retinopathy." Arch Ophthalmol 66: 366-78
2. Hardarson, S.H., A. Harris, et al. (2006). "Automatic retinal oximetry." Invest Ophthalmol Vis Sci 47(11): 5011-6.

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