

#### A NEW SYSTEM FOR AUTOMATIC ON-LINE MEASUREMENT OF RETINAL VESSEL DIAMETER

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##### Purpose

At present there is no method known, which allows to measure retinal vessel diameter with sufficiently minimal error. We present a system for the automatic measurement of the diameter of human retinal branch vessels. The system allows to perform on-line measurements directly at the human fundus.

##### Methods

A measuring ophthalmoscope based on the Zeiss retina camera RC 310 is coupled with a CCD device. A frame grabber digitizes the picture section with the interesting vessel segments. An adaptive algorithm recognizes the position and direction of the vessels automatically and calculates the vessel diameters. Other measuring data are recorded additionally, for example the R - spike of the electrocardiogram. This additional information can be used for the measurement of the pulsating changes of the vessel diameter.

##### Results

The retinal vessel diameter is measured under on-line conditions. The standard deviation of the measured diameter values depends on the duration of measuring time. Between different sessions it is smaller than 3%.

##### Conclusions

The presented measuring system is suitable for the registration of clinically relevant and therapeutically induced vessel diameter changes down to 1 to 3%.

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#### REPRODUCIBILITY AND ERROR SOURCES IN AUTOMATIC DIAMETER MEASUREMENT OF RETINAL BRANCH VESSELS

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##### Purpose

A measuring ophthalmoscope based on the Zeiss retina camera RC 310 coupled with a CCD device with analogous and digital fundus image storage was developed in Jena. The system is used for automatic measurement of retinal vessel diameter. The reproducibility of computerized diameter measurement attained to a sample of branch vessels in the retinal background of 30 human eyes is investigated (1 retinal artery and vein each).

##### Methods

The vessel diameter was measured at a distance of 0.25 to 1.5 times the papillar diameter from the border of papilla in each case. Before starting a new video sequence another spatial adjustment between eye and fundus camera is achieved. From each patient 3 measuring series were recorded. The automatic evaluation of fundus video sequences was based on adaptive algorithms.

The parameter relevant to the random error of diameter achievable in follow - up observations is the intraindividual reproducibility between different sessions. It is characterized by mean standard deviation from measured vessel diameter value.

##### Results

The standard deviation achieved for the central part of the image field is  $(2.2 \pm 0.7) \%$  for arteries and  $(1.8 \pm 0.5) \%$  for veins. Providing sufficiently good image quality within video sequences of the same measuring session the standard deviation achieves values of 1 % and less.

##### Conclusions

The difference between both values of reproducibility is assumed to be caused by unavoidable differences in spatial adjustment between measuring device and eye.

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#### LONG TERM FOLLOW-UP OF RETINAL AND CHOROIDAL STRUCTURES AFTER EXPERIMENTAL VASCULAR THROMBOSIS USING CHLOROALUMINUM SULFONATED PHTHALOCYANINE AND A DIODE LASER

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Purpose. The effectiveness of phthalocyanine-mediated photothrombosis of normal retinal and choroidal vessels was evaluated in 25 albino rabbits.

Methods. A selected area of fundus including big retinal vessel of temporal wing and surrounding retina was irradiated in each rabbit using a 570 nm diode laser ( 2 mW, 0.5 mm<sup>2</sup> ), after the injection of chloroaluminum sulfonated phthalocyanine ( 5 mg/kg ). Animals ( 25 albino rabbits ) were followed up to a maximum of 14 months using fundus photography, fluoroangiography and histology.

Results. Photothrombosis of the irradiated vessels occurred in all treated eyes after 13 to 17.5 min of irradiation. The retinal vessels were patent again by the 7th day after the procedure. Choroidal vessels remained closed during the whole follow-up period. Light and electron microscopy demonstrated occupation of irradiated choroidal and retinal vessels by platelet thrombi. Damage of endothelial cell structure of these vessels could be seen. *Outer retinal and retinal pigment epithelium* damage was observed in the irradiated area. By the end of the first week after irradiation, the structure and the blood flow of the retinal vessels were close to normal, while the choroidal vessels remained closed. By the end of the first month, the choroidal vessels were completely destroyed. After 18 months of follow-up, no signs of restoration of choroidal blood circulation were observed.

Conclusions. The combination of phthalocyanine with a low power diode laser irradiation is a simple and effective way for induction of photodynamic thrombosis in fundus vessels.

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#### HIGH ALTITUDE RELATED VISUAL LOSS: ONE CASE REPORT.

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Purpose: To discuss the factors leading to visual impairment after oxygen therapy, during a high altitude trek .

Methods: A 33 year old woman was treated by hyperbaric oxygen therapy for high altitude sickness following a night spent at 4850m. She experienced a central visual loss in her right eye fifteen minutes after ending the treatment and being exposed to daylight without protection. She also complained of erythropsia and central scotoma.

Results: Full ophthalmological examination was performed in our institution three weeks later, the patient still suffering from her central scotoma. Right visual acuity was 20/100 Parinaud 3, the anterior segment and IOP were normal, and fundus examination showed a mild parafoveal depigmentation, and no outer retinal layer lesion. Fluorescein angiography was normal and SLO examination confirmed the scotoma described by the patient. Eight months later, the visual field defect has diminished in size and vision has raised to 40/80

Conclusions: Retained diagnosis was retinal hemorrhage, although light-induced trauma, or microvascular infarction could have been considered. Oxygen therapy could have played a role mediated by increased production of free radicals. The different hypothesis are discussed according to experimental data.