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MODEL OF RETINAL MICROCIRCULATION

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Purpose
We introduce a program to study the essential dependencies between measurable and unmeasurable parameters of retinal microcirculation in a more sophisticated way.

Methods
The retinal vessel system is divided in four quadrants, each with five parts of vessels, which consist of parallel connected vessels with similar physiological relations in each case. By means of nonlinear flow - pressure relations you can verify in separate vessels bloodflow, velocity of blood, decrease of pressure and flow resistance. Values founded by measurement technique are used as input - information to start the simulation.

Results
Measured values of vessel diameter, blood velocity and other physiological parameters allow the simulation of non directly measurable parameters, such as pressure, flow resistance etc. The study opens a more sensitive way of diagnosis based on patho-physiological facts.

Conclusions
The model allows a biophysical interpretation of measuring results and, furthermore, the simulation of physiological and pathological relations and therapeutical effects on the retinal microcirculation.

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CONFOCAL THREE-DIMENSIONAL ANALYSIS OF THE RETINAL VASCULATURE

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Purpose. To describe a new technique to study the retinal vasculature in three-dimensions using the confocal laser scanning microscope.
Methods. Flat preparations of postmortem human and bovine retinas were immunostained against various blood and blood vessel components (von Willebrand factor, serum albumin). Staining was localised by indirect immunofluorescence and images examined with an MRC 600 confocal laser scanning attachment (Biorad).
Results. Immunofluorescent staining for von Willebrand factor and serum albumin was present in vessels of all sizes. Using the confocal microscope images of the capillary network at various depths throughout the retina could be obtained which were free from out-of-focus blur. 3D impressions of the confocal images were achieved by creating either a stereo-pair or a red green stereo anaglyph. Dual staining techniques, using propidium iodide and fluorescein conjugated probes, demonstrated the co-localisation of cells and serum components in retinal vessels.
Conclusion. The simple staining technique described in this study, together with the use of confocal microscopy, permits accurate 3-dimensional reconstruction of the retinal vasculature without destroying overall tissue architecture. Additional advantages of this technique include; 1) it can be undertaken on fresh or fixed retina, 2) whole eyes are not required, the technique being applicable to small segments of retina, and 3) it can be used to study pathological changes in the retinal vasculature.

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MORPHOMETRIC CHANGES IN RETINAL VASCULATURE ARE ASSOCIATED WITH ESSENTIAL HYPERTENSION

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Purpose: To analyze retinal vascular morphometry in essential hypertension (EH), renovascular hypertension (RVH) and compare with healthy age and sex matched controls (C). Vascular rarefaction may contribute to the development of hypertension via increased resistance. However, the current classification of vascular changes in hypertension does not correlate with its complications.
Methods: 10 EH, 9 RVH and 8 controls were studied by funduscopy (CANON 60°). Vascular density (Lc) was measured from the photographs and separately analyzed for the nasal and temporal side.
Results: (expressed as medians and interq. range) For EH and RVH patients diameters were higher for temporal arteries (0.21 (0.19-0.24) and 0.21 (0.18-0.24)) and nasal veins (0.20 (0.16-0.23) and 0.20 (0.17-0.27)) as compared to C (0.15 (0.13-0.19), p=0.05 and 0.14 (0.13-0.18), p=0.03 respectively). Total temporal Lc was lower in EH (0.044 (0.039-0.048)) patients when compared to RVH (0.050 (0.041-0.053)) and C (0.049 (0.048-0.052), p<0.05), which was mainly due to decreased venous density.
Conclusion: The fact that vascular rarefaction was observed in EH but not RVH, suggests that rarefaction is not due to hypertension per se, but may play a primary role in the pathogenesis of EH. In contrast, the increased vascular diameters are probably induced by hypertension, as they were seen in both EH and RVH.

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RESULTS OF ONLINE MEASUREMENTS OF RETINAL VESSEL DIAMETERS ON PATIENTS

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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 storage of retinal fundus image was developed in Jena. The system is used for automatic online measurements of vessel diameters. It is known, that the vessel diameter performs pulsations, which are usually not to be seen. The vessel diameter is defined as the statistical local and temporal expectation value of the diameter of the red blood cell column. The size of pulsations of retinal vessels and their influences on retinal vessel diameters were explored.

Methods
The retinal vessel diameters were measured on both eyes in a distance of 0,25 to 1,5 times of the papillar diameter round the papilla. The pulsation of retinal vessels was identified by simultaneous registration of an electrocardiogram. We have measured the retinal vessel diameter on patients with different disease.

Results
The measurements of vessel diameters had shown that the pulsations of retinal vessels appear in a range of five percent or less.

Conclusions
The pulsation of retinal vessels don't have any effect on measurement of vessel diameters if the vessel diameter is defined as the statistical determined local and temporal mean of a sufficiant number of randomly distributed measuring values.

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