Prof. Dr.-Ing.habil. M. Krauß, Prof. Dr. Fischer AG Chemnitz
Dr. med. G. Grohmann, Klinik Bergfried Saalfeld
Dr. med. V. Rasch, Augenklinik Potsdam
Prof. Dr.-Ing.habil. mult. J. Waldmann, MIRA GmbH Chemnitz

Blood flow changes in the retina in the case of normal probands under the QRS therapy as well as before and after sublingual administration of 0,4 mg trinitroglycerin– results of a preliminary study

1 Introduction

Important works on the use of the magnetic field therapy on the **ophthalmology** were mainly published in the former Soviet Union (up to 1980, already 50 dissertations; abstracts of essential works are contained in the literature overview "The effect of pulsating magnetic fields in the ELF range applied to the animal and to the human being" that was provided to the authors by the Magnovit International AG Eschen /Liechtenstein). Independently of the form of the magnetic field, there is stated as a summary /8/ (taken from the literature overview mentioned above):

• There is a positive effect on the epithelization of the cornea. The blood vessels in the retina are dilated. In the magnetic field, a lower intraocular pressure is created. In part, in case of therapy resistance, the field can activate the blocked blood feed to the retina.
• The magnetic field has a pain-reducing effect.
• Haematomas disappear faster.
• In 50 % of the cases, the glaucoma treatment is positive even if the drug treatment is not successful.
• Neither in the eye nor in the brain tissue, negative side effects have occurred.

Within a preliminary study, there shall be examined whether blood vessels in the retina dilate analogously to the cardiovascular system /7, 14/ in the case of normal probands when a magnetic field therapy using the Salut 1 QRS® Quantron Resonance System device is applied. Furthermore, comparative measurements before and after a sublingual administration of 0.4 mg trinitroglycerin shall be performed.

2 Examination persons and methods

Examination persons: Four voluntary, clinically healthy persons (1 woman, 3 men) having an average age of 58.3 ± 1.8 years were treated. The state of the eyes was according to the age. All four persons had reading glasses of medium strength prescribed by the physician. The measurements were carried out in a quiet room in the morning between 8:00 a.m. and 11:00 a.m..

QRS magnetic field therapy: To the backside – head-neck-shoulder region – of the sitting test persons, a small QRS therapy mat ("coil cushion") was attached. These test persons were treated using the QRS® Quantron Resonance System device for 8 minutes.

To compare occurring changes on a QRS therapy, 0.4 mg **trinitroglycerin** were sublingually administered to one test person. As known, a nitrate fed in this way – as the endogenously nitrate does – dilates the vessels. Thus, nitroglycerin is a stimulus by means of which the vasodilation can be stimulated in an endothelium-independent manner. In the cardiovascular system, this effect can be acquired non-invasively by means of high-resolution ultrasound duplex equipment, the laser Doppler flowmetry, the NIRP method /7/ and the vein occlusion plethysmography.

The examinations of the ocular fundus during the influence of the QRS magnetic field as well as under trinitroglycerin were performed using the Heidelberg Retina Flowmeter produced by HEIDELBERG ENGINEERING /5/. The Heidelberg Retina Flowmeter combines two specific measuring techniques – the confocal laser scanning technique and the laser Doppler flowmetry – to form a novel device for the non-invasive and two-dimensional mapping of the retinal microcirculation /5/.

On an examination using the *Heidelberg Retina Flowmeter*, the retina or the pupil is two-dimensionally scanned with an infrared laser beam. Due to the optical Doppler effect, light that is reflected or scattered from moved red blood cells is subject to a frequency change. It interferes with light that is reflected at non-moved structures in the surrounding tissue and retains its original frequency. This interference causes a characteristic variation of the detectable intensity of the light that is reflected at a certain place. By means of the Heidelberg Retina Flowmeter, these intensity variations are measured at each point of a two-dimensional scanning field and are used to determine the local Doppler frequency change and, thus, to quantify the local blood flow. This leads to a two-dimensional representation of the retinal blood flow with a spatial resolution at capillary level. The size of the measuring field on the retina amounts to 10° * 2.5° to 20° * 5°. Inside this field, in total, 256 * 64 (16,384) independent laser Doppler measurements are performed. The total data taking time amounts to 2 seconds. For data taking, a pupil dilation is not required. The data are evaluated in less than one minute. At that, two-dimensional blood flow maps are created that allow a visualization of the network of active capillaries and vessels. Moreover, in a certain sense, local blood flow parameters such as speed, flow and volume can also be determined quantitatively. The operating software of the device is running on a personal computer under DOS or Windows 95. It comprises database functions, image pick-up, image processing, contrast amplification, creation and printing of examination reports as well as image archivation /5/.

3 Results

Figure 1 shows a retina section with small arteries acquired with the Heidelberg Retina Flowmeter, as well as an analyzed window from which the corresponding blood flow volume is derived. In the case of the corresponding test person, such a window was kept (nearly) constant before and during the QRS therapy; otherwise, the measuring point was varied. In the case of each test person, the arithmetic mean value for the chosen measuring point was calculated from the measuring values before the therapy. All succeeding measuring values, i.e. those under the therapy, were divided by this mean value. With that, the **relative** changes both under the QRS therapy and under trinitroglycerin can be determined, related to the mean blood flow volume before the therapy in the window used as basis (normalized mean value = 1 in the case of each test person).

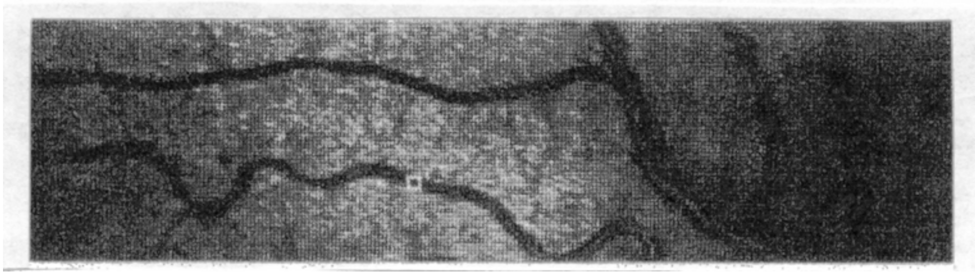
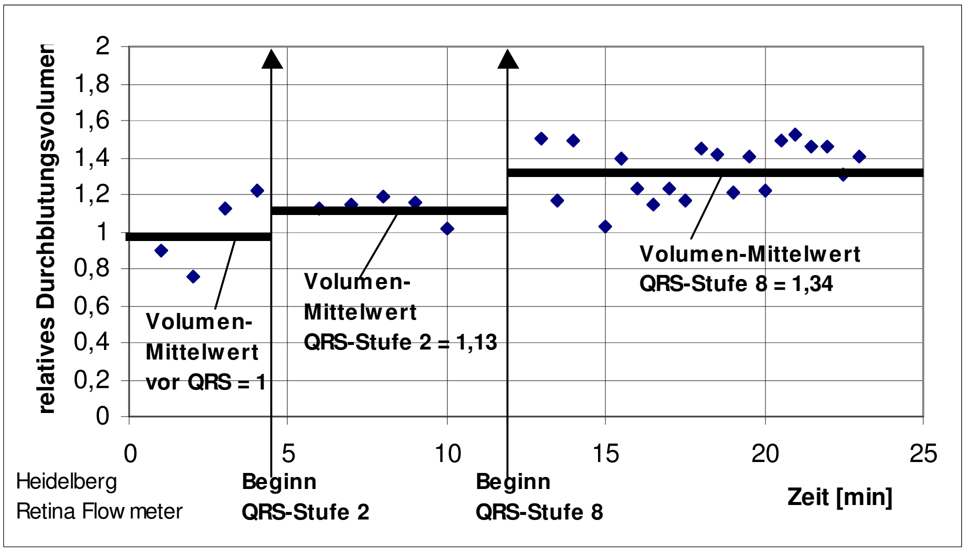


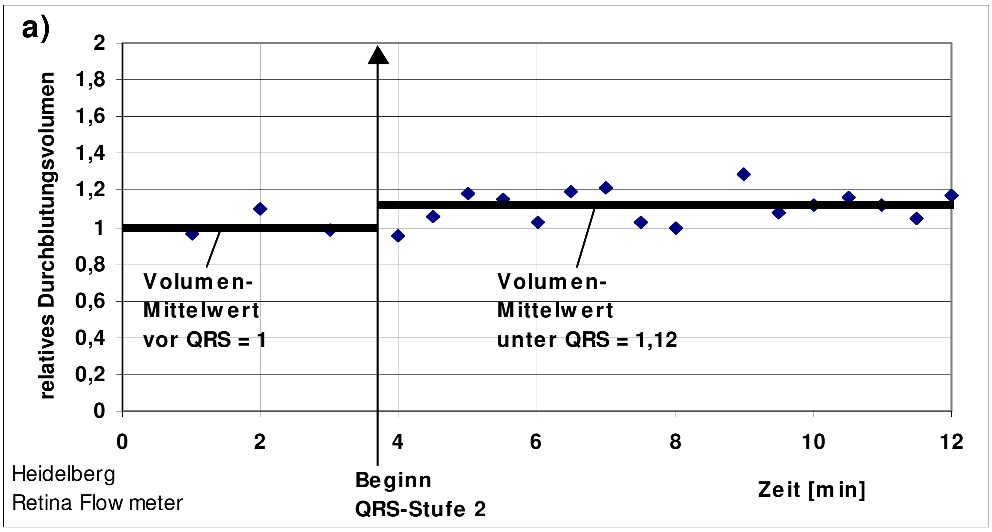
Figure 1: Retina section A with small arteries acquired with the Heidelberg Retina Flowmeter, as well as an analyzed window

Figure 2: Blood flow changes in a small eye artery of the retina under QRS therapy (before QRS, QRS levels 2 and 8) in the case of a 60 years old female proband



1 – Relative blood flow volume
1.a – Dezimalkommas → Punkte
2 – Volume mean value before QRS = 1
3 – Volume mean value under QRS level 2 = 1.13
4 – Volume mean value under QRS level 8 = 1.34
5 – Heidelberg Retina Flowmeter
6 – Beginning of QRS level 2
7 – Beginning of QRS level 8
8 – Time [min]

After the shown algorithm, the following measuring values were obtained in the case of the test persons under the corresponding magnetic field intensities. **Figure 2** shows the mean values before QRS as well as under the levels 2 and 8 in the case of a 60 years old female proband. Analogously, **Figure 3** shows the mean values in the case of a 58 years old male patient (Figure 3a: under QRS level 2, Figure 3b: under QRS level 8), **Figure 4** shows the mean values in the case of a 60 years old male patient (Figure 4a: under QRS level 2, Figure 4b: under QRS level 8), and **Figure 5** shows the mean values in the case of a 55 years old male proband under level 8 only. In **Figure 6**, for the male proband of Figure 4, the changes after a sublingual administration of 0.4 mg trinitroglycerin are shown as comparative representation.



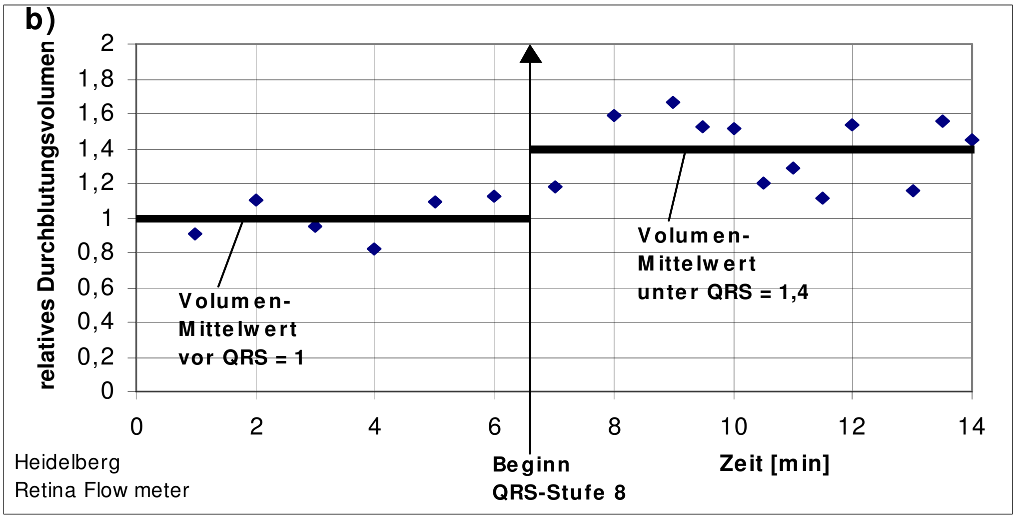


Figure 3: Blood flow changes in a small eye artery of the retina under QRS therapy [a) level 2, b) level 8] in the case of a 58 years old male proband

1 – Relative blood flow volume
1.a – Dezimalkommas → Punkte
2 – Volume mean value before QRS = 1
3 – Volume mean value under QRS = 1.12
4 – Heidelberg Retina Flowmeter
5 – Beginning of QRS level 2
6 – Time [min]
7 – Volume mean value under QRS = 1.4

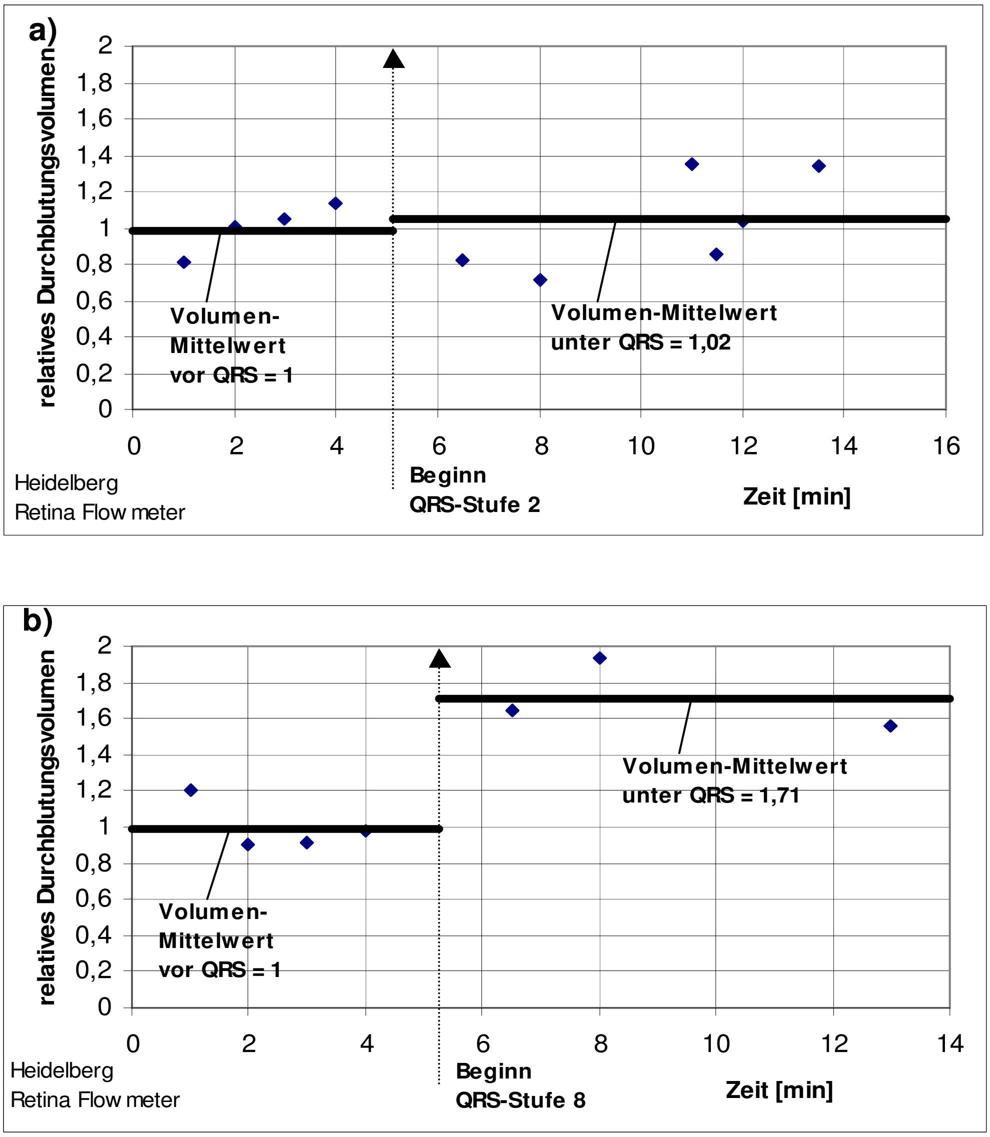


Figure 4: Blood flow changes in a small eye artery of the retina under QRS therapy [a) level 2, b) level 8] in the case of a 60 years old male proband

1 – Relative blood flow volume
1.a – Dezimalkommas → Punkte
2 – Volume mean value before QRS = 1
3 – Volume mean value under QRS = 1.02
4 – Heidelberg Retina Flowmeter
5 – Beginning of QRS level 2
6 – Time [min]
7 – Volume mean value under QRS = 1.71

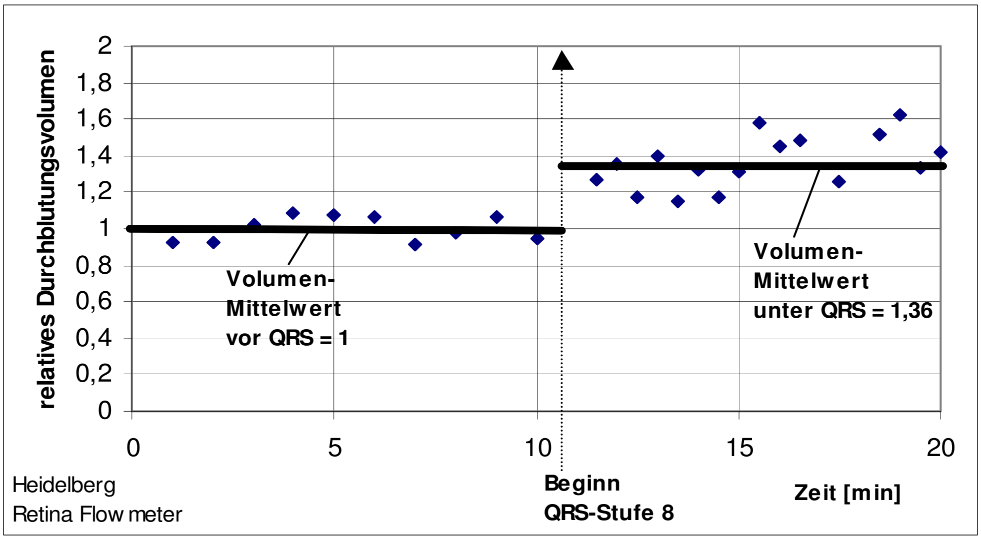


Figure 5: Blood flow changes in a small eye artery of the retina under QRS therapy [level 8] in the case of a 55 years old male proband

1- Relative blood flow volume
1.a – Dezimalkommas → Punkte
2 – Volume mean value before QRS = 1
3 – Volume mean value under QRS = 1.36
4 – Heidelberg Retina Flowmeter
5 – Beginning of QRS level 8
6 – Time [min]

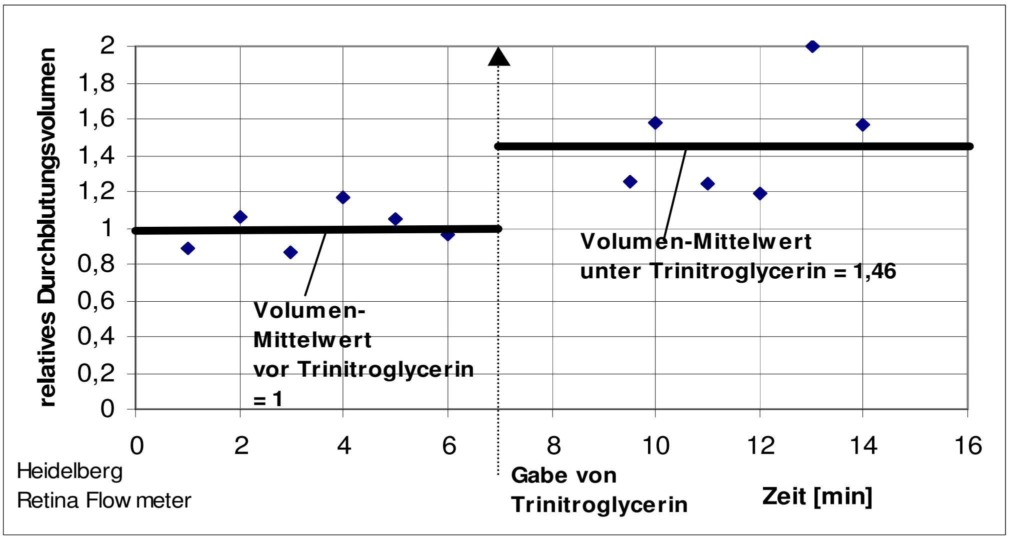


Figure 6: Blood flow volumes in a small eye artery before and after the sublingual administration of 0.4 mg trinitroglycerin in the case of a 60 years old male proband

1 – Relative blood flow volume
1.a – Dezimalkommas → Punkte
2 – Volume mean value before trinitroglycerin = 1
3 – Volume mean value under trinitroglycerin = 1.46
4 – Heidelberg Retina Flowmeter
5 – Administration of trinitroglycerin
6 – Time [min]

To determine the dependence of the appearing relative blood flow changes in the case of the 4 test persons independently of the measuring point, all measuring values before the therapy as well as under the corresponding QRS magnetic field levels (intensities) 2 and 8 were summarized in a diagram as shown in **Figure 7**. The obtained arithmetic mean values and the standard deviations are shown in **Table 1**.

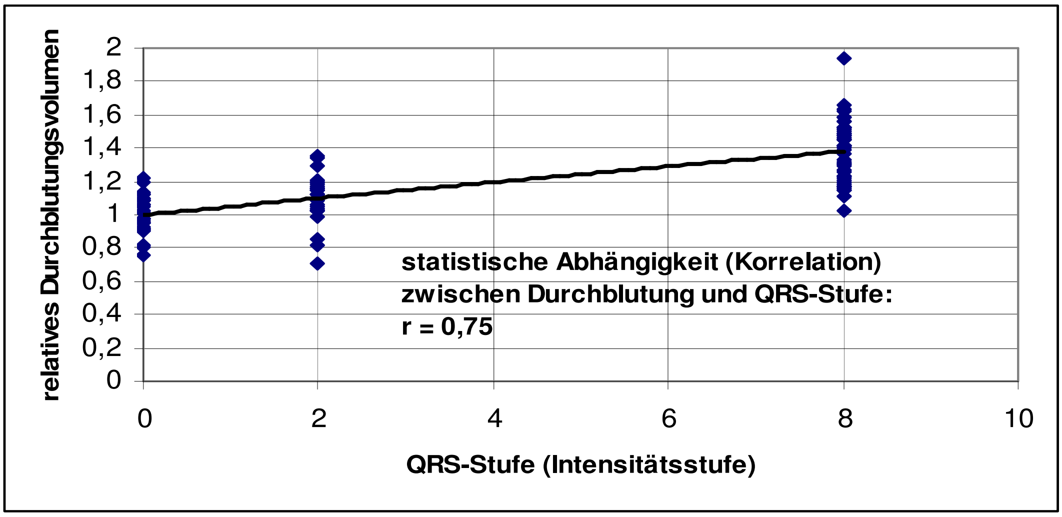


Figure 7: Dependence between the relative blood flow volumes and the QRS magnetic field levels 2 and 8 in the case of the 4 test persons, independently of the measuring point

1 – Relative blood flow volume
1.a – Dezimalkommas → Punkte
2 – Statistical dependence (correlation) between blood flow and QRS level: r = 0.75
3 – QRS level (intensity level)

QRS- level	Arithmetic mean values of the relative blood flow volumes	Standard deviation
– Before therapy	1	0,09
2	1,1	0,11
8	1,39	0,15

Table 1: Arithmetic mean values including standard deviations of the relative blood flow changes of the 4 test persons in case of the QRS magnetic field levels, derived from Figure 7

4 Discussion

The represented results show for the 4 test persons under QRS therapy: With an increase of the intensity of the QRS magnetic field, the blood flow volumes in the windows used as basis – i.e. independently of the measuring point – will increase too. Thus, a vasodilation occurs that can be different and possibly depends on the vessel state. That the process does not have a linear course, this is shown by the scatters of the measuring values around the respective mean values. However, a reason for the scatters could also consist in the measuring accuracy of the Retina Flowmeter.

Obviously, the occurrence of a vasodilation in case of an increase of the magnetic field intensity (Figures 2 to 5) also shows that the vessels of the retina – in contrast to the vessel periphery – are not innervated by the sympathicus. In a work of the authors not published up to now, there is shown: With an increase of the QRS magnetic field intensity, the peripheral sympathicotonus is increased and, thus, a peripheral narrowing occurs. At the same time, there is pointed to the fact that this causes a reduction of the NO production. Inversely, a low QRS level causes a reduction of the peripheral sympathicotonus and, thus, a vessel extension. Obviously, this does not occur in the retina.

The effect of exogenously fed trinitroglycerin is shown in Figure 6. The results are comparable with those under magnetic field therapy: The sublingually fed nitrate has a vessel-dilating effect as the endogenously created nitrate does. Thus, nitroglycerin is a stimulus by means of which the vasodilation can be stimulated in an endothelium-dependent manner.

Between the QRS level and the appearing magnetic field intensity, there is a completely linear relation: minimally selectable field strength of 2 µT at the level 1, field strength of 20 µT at highest level 10. Figure 7 shows that the approximate assumption of a linear correlation between the relative blood flow volumes and the magnetic field intensities seems to be justified because a relatively high correlation factor of $r = 0.75$ resulted in the case of these 4 test persons. Whether such a dependence in the case of normal probands appears generally, this has to be ascertained in further examinations. If endothelium affections (for example, in the case of diabetics), such a correlation occur scarcely as it was analyzed in studies.

Whether the changes listed in Table 1 will prove to be normal ranges, this has to be determined in the case of a greater number of test persons.

5 Outlook

In the plenary lecture "QRS magnetic field therapy – presence and future", there was shown: At the vessel endothelium, in the most general sense, the control of the synthesis of **nitrogen monoxide** (NO) /3, 4, 6, 7, 9, 10, 11/ and **prostacyclines** as vasodilators takes place, also activated by the specifically formed QRS magnetic field /1, 2, 12, 13/. As Kelm /6/ states, nitrogen monoxide is created by the endothelium cells already in the resting state and essentially contributes to the regulation of the vessel tonus, i.e. of the blood flow and pressure. On the other hand,

in case of various diseases of the cardiovascular system in the early stage, the vessel endothelium is affected and the protective effect of NO as vasodilator and thrombocyte inhibitor is not present (occurrence of endothelium dysfunctions) as stated in /6, 9, 10/. Furthermore, it is known that NO set free from endothelium cells into the blood is first oxidized in the plasma to nitrite that is converted to nitrate very quickly that is eliminated in the urine /6/. The oxidation is also referred to as a "deactivation mechanism for NO". It is very likely that this mechanism is the reason for the fact that the production and the drain of the ocular humor hold the balance and a constant intraocular pressure results. If the NO production is reduced in case of a endothelium dysfunction, the intraocular pressure can rise pathologically, the optic nerve can be affected and a glaucoma can occur. If a strong endothelium dysfunction is present, after /9/, an increased NO catabolism is released by an activation of the renin-angiotensin system (RAS).
If there is stated in /8/ that a glaucoma treatment using a magnetic field could be assessed as positive in 50 % of the cases, then the mentioned NO deactivation mechanism should be the reason for that.
The possible applications of the QRS magnetic field therapy in the entire ophtalmology stated as an outlook have to be examined in future works.

References

/1/ Fischer, G. und U. Warnke: Einrichtung zur Ermittlung der Wirkung gepulster Magnetfelder auf einen Organismus. Europäische Patentschrift EP 0 729 318 B1.

/2/ Fischer, G.: Grundlagen der Quanten-Therapie. HECATAEUS-Verlagsanstalt 1996.

/3/ Forth, W. u.a.: Pharmakologie und Toxikologie. Spektrum Akademischer Verlag Heidelberg/Berlin/Oxford 1996.

/4/ Grobecker, H.-F., W. R. Kukovetz: Organische Nitrate: Neue Aspekte zum Wirkungsmechanismus und zur therapeutischen Anwendung. Arcis München 1992.

/5/ Heidelberg Engineering: Firmenschrift zum Heidelberg Retina Flowmeter.

/6/ Kelm, M.: Kardiovaskuläre Wirkungen von Stickstoffmonoxid und ihre Bedeutung für die arterielle Hypertonie. Schattauer Stuttgart/New York 1996.

/7/ Krauß, M. und G. Grohmann: Messung von peripheren Kreislaufparametern mit der nichtinvasiven NIRP-Methode bei pulsierender Magnetfeldtherapie mit dem Quantronic-Resonanz-System Salut 1. Ärztezeitschrift für Naturheilverfahren 38, 7 (1997), 491-502.

/8/ Mitbreit, M. I.: Use of Magnetic Fields in Ophthalmology. Medizinisches Institut Moskau, Rußland: Vestnik oftalmologii 4, 69-72 (1980).

/9/ MMW: Endothel-Dysfunktion. Neue Aspekte der ACE-Hemmung. MMV Medizin München 20/1997.

/10/ Schmidt, H. H. H. W.: NO, endogener Botenstoff und Zellgift. MED. MO. PHARM. 17, 6 (1994), 168 - 185.

/11/ Thews, G. und P. Vaupel: Vegetative Physiologie. 3. Aufl.. Springer Berlin/Heidelberg/New York/Barcelona/Budapest/Hongkong/London/Mailand/Paris/Santa Clara/Singapur/Tokio 1997.

/12/ Warnke, U.: Einrichtung zur Beeinflussung von elektrischen und magnetischen Feldern niedriger Frequenz. Europäische Patentschrift EP 0 621 795 B1.

/13/ Warnke, U.: Fischer, G. und H.L. König: Vorrichtung zum Transport von Ionen, insbesondere Protonen. Europäische Patentschrift EP 0 594 655 B1.

/14/ Warnke, U.: Der Mensch und die 3. Kraft. Popular Academic Saarbrücken 1994