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## The intravenous laser blood irradiation - Introduction of a New Therapy

### Abstract

**Background:** The intravenous laser blood irradiation was accomplished for the first time approximately 25 years ago in the former Soviet Union. Laser light is brought directly into the blood flow. First various in-vitro-tests verified that biological soft laser irradiation of white blood cells caused various positive effects, in particular expression of immunoglobulins, interferons and interleukins make a significant difference. After the introduction of the method various studies were published, showing additional effects on various metabolic pathways.

**Objective:** In the presented work the virtually pioneering Russian publications on the therapy of chronic

liver diseases, fat metabolism disorders and diabetes mellitus are reproduced.

**Method:** The development and certification of a new intravenous laser blood irradiation device in the research support program Biophotonik II of the government of Lower Saxony in 2005, opened the possibility, to use this up to now in Germany for the most part unknown therapy in clinical studies with patients for the first time.

**Results:** Personal investigations confirmed the results of the mainly Russian publications to a large extent. It turned out in almost all patients a general stabilization and energy boosting and manifold positive effects on chronic liver diseases, diabetes mellitus, and fat metabolism disorders, and

various additional diseases.

**Discussion:** The biological mechanisms of intravenous laser blood irradiation are only partially known until now and partly hypothetical and further intensive research is required.

**Conclusion:** The new method of intravenous laser blood irradiation and the availability of an equivalent device are possibly opening new ways in the therapy of systemic metabolic and immunological diseases.

### Keywords

Low Level Lasertherapy, Intravenous Laser Blood Irradiation (ILBI), One-way catheter, Immune System, Metabolic Processes, Biological Laser therapy

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### Abstract

**Background:** Intravenous laser blood irradiation was accomplished for the first time approximately 25 years ago in the former Soviet Union. Laser light was brought directly into the blood flow through a one-way-catheter. Various in-vitro-tests verified that biological soft laser irradiation of white blood cells caused various positive effects, in particular expression of immunoglobulins, interferons and interleukins.

After the introduction of the new method various clinical studies were published, showing additional effects on various metabolic pathways.

**Objective:** In the presented work the mainly Russian publications on the therapy of fat metabolism disorders,

chronic liver diseases and diabetes mellitus are reproduced. **Methods:** The development and certification of a new intravenous laser blood irradiation device in 2005 in the research support program Biophotonik II of the government of Lower Saxony opened for the first time the possibility in Germany to check the new therapy in clinical studies.

**Results:** In our research the results of the Russian studies could be confirmed to a large extent. Nearly all treated patients described general stabilisation, energization and positive effects on chronic liver diseases, Diabetes mellitus, metabolism disorders and other various diseases. **Discussion:** The biological mecha-

nisms of intravenous laser blood irradiation are until now only partially known or guessed at and further intensive clinical research will be necessary.

**Conclusion:** The new method of intravenous laser blood irradiation and the availability of a certified device are possibly opening new ways in the therapy of systemic metabolic and immunological diseases.

### Keywords

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## 1. Introduction

The method of intravenous laser blood irradiation was first introduced into therapy by the Soviet scientists E.N.Meschalkin and V.S.Sergiewski in 1981 [31]. Originally this method was developed for the treatment of cardiovascular diseases. Improvement of rheologic properties of the blood as well as improvement of micro circulation and reduction of the area of infarction had been proved. Further reductions of dysrhythmia and sudden cardiac death occurred [3,20]. At first only the helium-neon-laser (632.8 nm) was used in this therapy. For that a power of 1-3 mW and a period of exposure of 20-60 minutes were applied. The treatments were carried out once or twice a day up to ten appointments in all. In the years after many, for the most part Russian studies showed that helium-neon-laser had various effects on many organs and on the hematologic and immunologic system. Because the method was to be

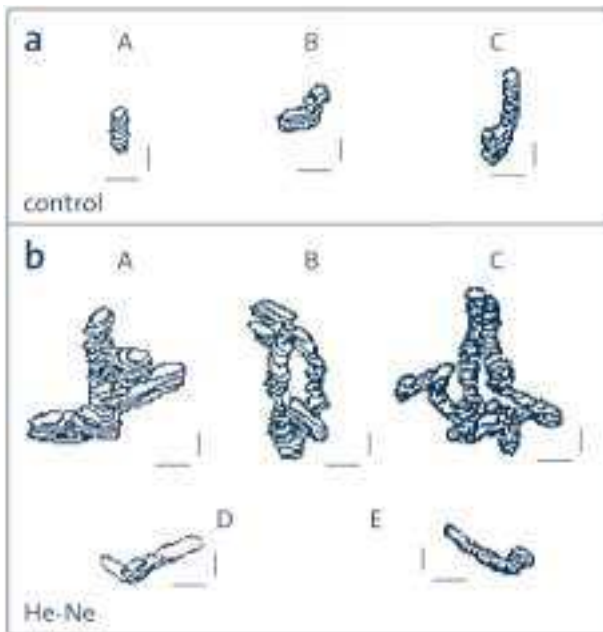
were published mainly in Russian which were little known in the West because of decades of political separation, and were met with disapproval.

Besides clinical research and application for patients the cell biological basis was developed by the Estonian cell biologist Tiina Karu at the same time. An abstract is to be found in her work "The Science of Low-Power Laser-Therapy" published in English [18].

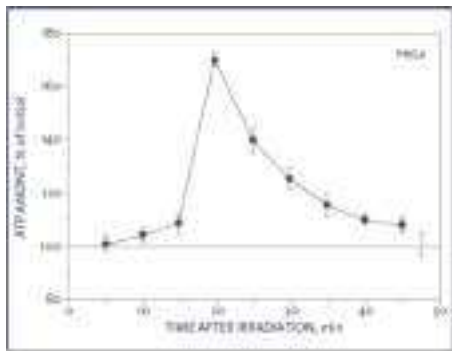
## 2. Effects and mode of operation of intravenous Low-Level-Laser-Therapy of the blood

1. Under laser blood irradiation anti-inflammatory effects were observed that improved the immunologic activity of the blood. An increase of

2. A fundamental finding was the positive influence on rheological properties of the blood which is of greatest interest to surgery, angiology and cardiology in particular [45]. A diminishing tendency of aggregation of thrombocytes and of forming property of erythrocytes result in an improved oxygen supply and with that to a decrease of partial which is particularly relevant to wound healing [9, 26, 51]. Furthermore the activation of phagocytic activity of makrophages was proved in conjunction with structural modifications [7, 21]. A positive effect on the proliferation of lymphocytes and B- and T-cell-subpopulations could be verified too [12, 45, 37].
3. pressure of carbon dioxide in the blood. As a result the hypoxia of the tissue will improve in future which leads to a normalization of the tissue metabolism. In addition the fibrinolysis will be activated [34]. Apart from the elimination of hypoxia and the normalization of tissue metabolism an increase of ATP-synthesis and by that a normalization of cell membrane potential will be the result [40]. Additional vasodilatation is leading to de-blocking of capillary and collateral vasa in connection with the described improved rheological properties of the blood together with an improved trophicity of tissues and normalization of neurosensory stimulation. What is more, the increased release of NO from monocytes obviously is of critical importance [28]. Because of the described effects the intravascular blood-irradiation is used in Russian surgical university-clinics pre-operative, to avoid thromboembolic complications, and postoperative, for a faster wound healing [11, 26]. In addition there are laser specific analgetic, spasmolytic and sedative effects [13]
4. There are reports on patients with chronic glomerulonephritis who had significant improvement of tolerability of medication (glucocorticoids, cytostatic drugs, diuretics) and of kidney function [29], in the same way an improvement of



Picture 1:  
mitochondria of human leucocytes before (a) and after irradiation (b) of human cells with helium-neon-laser 632  
source: Manteifel et al. [30]



picture 2: Increase of ATP with laser-irradiation (632 nm) of HeLa-cell culture source: Karu [18]

Inflammation parameter in acute pyelonephritis [6]. In necrotising pancreatitis an improvement of blood picture and of the immunological parameters had been proved too.

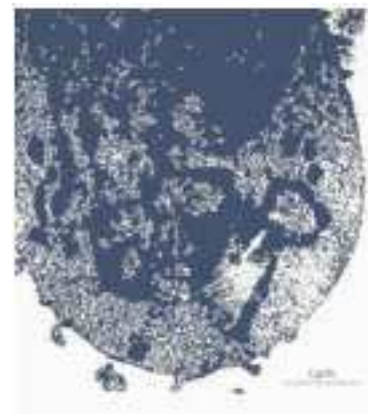
4. Intravenous blood irradiation is in wide use in obstetrics and gynecology to stimulate utero-placental exchange transfusion and as a prophylaxis and therapy of inflammations of the interior genitals [10].
5. For the further it was observed that mitochondria changed to so called "giant mitochondria" (picture 1) with laser-irradiation by activating various ways of metabolism and by increasing the production of ATP [30] (picture 2).

The "giant mitochondria" electron microscopically show themselves to be intracellular annular ("ring-shaped") structures (picture 1 and 3).

These mitochondrial changes cannot be put on a level with pathological giant mitochondria as they appear in certain clinical syndromes. We know the development of pathological giant mitochondria with swelling of organelles and deposit of pathological paracrystalline albumins e.g. with specific myopathies [42]. These changes account for a reactive phenomenon, but not for primary structural alterations.

The structure of mitochondria may vary strongly according to type of cell. They can impress as sausage shaped organelles, but may also form a highly branched out intercommunicating tubular network.

Observations of fluorescence marked mitochondria in live cells have shown that they are dynamic and may vary their shape strongly. Above all it is important that mitochondria may merge with each other, or divide. Probably the balance between fusion and division is decisive for the shape and form of a mitochondrion [17]. It was shown in histological researches on helium-neon laser irradiated lymphocytes that with the development of so called giant forms the number of mitochondria was diminishing simultaneously, but the total volume was unchanged. It was detected that the cause of the development of "giant mitochondria" was a fusion of smaller mitochondria [1, 30]. Manteifel and Karu proved big branched out forms of mitochondria in germinating yeast cells, but after laser-irradiation an expansion of the tubular network developed without damaging the organelles [31]. These mitochondria are marked by a relative enlargement of surface of the cristae mitochondriales due to activation of the respiratory chain and ATP-synthesis. Not to fail to mention that the description of the development of mitochondria to giant mitochondria is meeting with opposition. Heine (reviewer of this article) is pointing out that there are no indications that such pathological forms of mitochondria will lead to an activation of varied ways of metabolism and to an increase of ATP-production. Heine described



picture 3: Ringshaped „Giant mitochondria" of irradiated human leucocytes with helium-neon-laser 632 nm source: Manteifel et al. [31]

the way of reproduction of mitochondria in 1979: Whenever there is a need of additional ATP they will divide, but not fuse with each other [16].

Obviously there seem to be generalized effects of the intravenous blood-irradiation on almost every organ system so that this therapy may be employed in the treatment of various diseases causally or additively. Gasparyan described the improvement of micro circulation specially in central nervous structures. In particular, this is strongly developed in the hypothalamus which has a highly developed vascular micro system. He assumes that the intravenous blood-irradiation is stimulating the functional activity

**TABLE 1**

**Described effects of intravascular laser blood-irradiation**

- Stimulation of immune response, non-specific and specific
- Increase of the immunoglobulines IgG, Ig and
- Stimulation of interferons, interleukins and TNF-alpha
- Stimulation of the proliferation of lymphocytes
- Increase of phagocytic activity of makrophages
- Lowering of CRP
- Improvement of the anti-oxidant enzymatic system with antitoxic effect
- Improvement of forming property of erythrocytes and of micro circulation
- Reduction of aggregation of thrombocytes
- Activation of fibrinolysis
- Stimulation of the NO-production in monocytes with vasodilatation and improvement of endothelial dysfunction and trophicity of tissues
- Fusion of mitochondria to "giant mitochondria" with increase of ATP-production in the respiratory chain
- Normalization of cell membrane potential

of hypothalamus and limbic system and as a result put into operation the activation of hormonal, metabolic, immunological and vegetative processes with mobilization of adaptive reserves [10].

### 3. Comparison of intravenous laser with ultraviolet radiation of the blood (UVB and HOT)

For the ultraviolet irradiation of the blood a certain amount of blood is taken out of the vein, anticoagulant means are added and after UV-C-irradiation supplied with a special instrument to the body by infusion again (UVB-therapy).

In haematogenous oxidation-therapy (HOT) the blood is frothed up with oxygen additionally before it will be irradiated with ultraviolet light [8]. As a result there are various positive effects, very similar to the effects for intravenous laser blood-irradiation mentioned above. Basically it is not surprising because in both types of therapy high-energy photons are administered to the blood - with stimulation of immunological and cellular biological processes, and influences on rheology. Comparing both methods, the difference lies in the fact that in intravenous laser blood-irradiation no blood has to be taken and no additional anticoagulants are required. The blood will not be cooled down or modified with intravascular therapy by means of a disposal catheter. There is no risk of aggregation with causing of coagula, and constant observation of the patient is not necessary.

The use of monochromatic laser-irradiation in contrast to non-monochromatic ultraviolet-irradiation is consider to be an additional advantage. Since nowadays we have essential understanding of absorption- and action spectra of the various intracellular macromolecules and electron-carrier-systems [18], calculated biological effects can be set off with defined wavelenghtes in

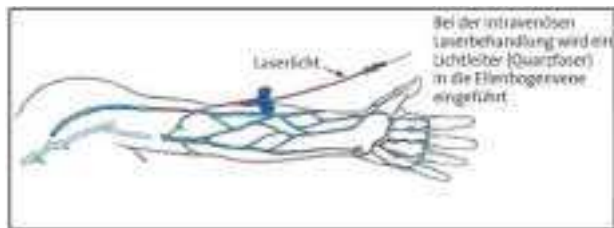
the catalytic centres of these structures. It is known fact that e.g. the cytochrome-C-oxidase-complex as the final link of the mitochondrial respiratory chain is absorbing in the red- and infrared range, and the NADH-complex as the first component is absorbing in the blue range. Another advantage of laser-light beside monochromasy is the coherence of the radiation which by means of particular order functions (in-phase-conformity of the waves) possibly has specific biological effects. A specific effect of coherence on cellular structures, is however discussed controversially.

Not least because light of the visible and the infrared spectrum is regarded as less dangerous than ultraviolet light. Today there is a well known borderline of 320 nm beyond that, ultraviolet light may cause fractures of the DNA-chains.

This risk does not exist in visible and infrared spectrum.

### 4. The viewing of intravenous laser blood-irradiation as "blood-acupuncture" in dissolution of blood stasis

In Chinese Medicine the term "Xue" is of great importance. It comprises the most important hyllic body juices including the blood. By means of the continuous circulation nutrients are transported to all organs and structures. Xue and Qi are closely linked to each other. In the TCM Qi is commanding the blood: when Qi is moving, the blood is moving, when Qi is stagnating, so blood is stagnating. Therefore it also says: Blood cannot flow without Qi, Qi cannot be held without blood [53]. Stagnation of blood and Qi are called blood-stasis-syndrome [36]. This we are trying to influence in classical acupuncture by needling specific points. Looking at blood-circulation hypothetically as a central interior meridian of its own, this method of stimulating the flow of blood and Qi by means of intravenous laser blood-irradiation



picture 4: Diagram of intravenous laser blood-irradiation inside of the elbow

could be perfectly called "blood-acupuncture". An interpretation of that kind could not be made with the ultraviolet-therapy of the blood mentioned above by definition.

### 5. The relationship of intravenous laser blood-irradiation with the system of basis-regulation according to Pischinger and Heine as well as on physiological leucocytolysis

The intravenous laser blood-irradiation is a biological therapeutic method that seems suitable to intervene in the system of basis-regulation. The meaning of this system is the functional connection between ENDSTROMBAHN, basic substance (extracellular matrix [ECM]) and cells.

The extracellular matrix is located between the capillaries and the cells, and represents a kind of molecular-sieve in which vegetative nerve fibres have their final spreading, and by that establish a connection to the CNS and the endocrinium (hypothalamus). This molecular-sieve presents the transit route of the entire metabolism from the capillaries to the cell and back. It is mainly formed by proteoglycans, glucosaminoglycans, structure-proteins like collagen, elastin and the networking-glycoproteins like fibronectin. There are various defensive cells in the ECM that control the synthesis and the decomposition of ECM-components by means of a cytokine-network.

By ageing and chronic oxidative stress with an increasing production of radicals, acidosis and clogging-up of ECM will grow, with a restriction of this vital molecular-sieve effect. A reduction of the antioxidant enzyme-system is additionally negative increasing. The increasing transferral of the transit route leads to micro- and macroangiopathies. The acidosis may furthermore encourage the forming and spreading of tumor cells through pro-inflammatory effects.

The described antioxidant, antiacidotic and antiinflammatory effects of intravenous blood-irradiation and the modulation of the immune system could have manifold effects on the system of basis-regulation and the extracellular matrix. Possibly there could be a certain protective effect on the development of tumor cells. It is possible that general ageing processes which go hand in hand with the above-mentioned clogging-up of ECM with pro-inflammatory effects and with increased formation of radicals, could be positively influenced. Seen from this angle the intravenous laser blood-irradiation could also be considered as antiaging therapy, in particular when combined with additional useful measures like diet, orthomolecular therapy, acupuncture, neural therapy or homeopathy. Another important aspect is the physiological leucocytolysis. Approximately 1.2 million leucocytes of the in all 1-2 billion leucocytes of the organism are in the process of disintegration every second. By this mechanism a great number of mediators like cytokins, chemokins, prostaglandins, leucotriens and many others are released. These immunomodulators can intervene to regulate changes of milieu

of blood plasma and extracellular matrix.

The ability of leucocytes to physiological lysis is according to Pischinger and Heine the "pivot of all naturopathic treatments" and measures of regulation medicine. You will find detailed presentation to these topics in "Lehrbuch der biologischen Medizin" by Heine [15]. It is obvious that the intravenous laser blood irradiation can stimulate physiological leucocytolysis similar to other immunomodulating therapies.

Respective researches for that are still pending.

### 6. Method: Actual Realization of Intravenous Laser Blood Irradiation

Intravenous laser blood irradiation is carried out with low power of 1-3 mW and a period of exposure of 20-60 minutes. As a rule a ten-part series of treatments will be carried out either once or three times a week with breaks at the in between weekends.

For intravenous laser blood irradiation first of all you have to feed in a cannula into a suitable vein at inside of the elbow or the forearm. The vein should have a wide lumen to catch a great volume of blood



picture 5: Intravenous laser blood irradiation with a 632 nm red light

in the period of time. In the Russian studies a simple steel-cannula was inserted in which a disposal laser plastic-catheter was fed in and was connected to a laser diode [picture 4]. This procedure was modified by the author by feeding in a blue cannula for children (Braun Medical, Melsungen) into a suitable vein and then a newly developed disposable laser-cannula made of biological compatible plastic is inserted into the vein (picture 5).

With veins that are difficult to puncture or if there is lack of practice, the setting of the cannula may cause problems, but recently a suitable little butterfly was developed which permits an easy application of the above described cannula. The advantage of this therapy is that it can be learned by an assistant, so the doctor has not to be right next to it all the time.

## 7. Results:

### 7.1 The Results of Cinical Studies

- An extensive study of the Academy of Medicine Wolgograd on 175 patients with chronic leaver diseases, including forms of chronic hepatitis and cirrhotic liver. Published in German translation, 2002 [42]. After a ten-part series of treatments with 630nm 1mW red light laser for 40 min a significant improvement of the antioxidant enzyme system and a long lasting significant reduction of pathological increased liver parameters was achieved.
- In 2002 several most interesting articles on the influence of long term complications and fat metabolism disorders with diabetes mellitus, were published by the Russian doctor Tatjana Kovalyova (Outpatient Department, 2. Municipal Clinic Izhevsk, Russia) Translated by Prof. Marti, Institut für LLLT & Naturheilkunde, Thun/Switzerland [23, 24]. The patients were treated in three ten-part series of treatments over a span of three months. his study was a so called combined laser therapy i.e. besides the in-

travenous laser-application in addition the regions of liver, pancreas and spleen were radiated transcutaneously. An almost statin equivalent reduction of lipid parameters was described too as well as a significant reduction of various typical diabetic complications such as retinopathies and angiopathies [23].

- D. Siposan and colleagues of Bucharest University, Romania, could prove in a study on 40 patients in August 2004 a significant improvement of the aggregation tendency of erythrocytes and a stabilization of the erythrocyte membranes [40].
- Even an improvement of the life-threatening situation of hemorrhagic shock could be shown in a study by Kozura and colleagues in 1993 [25].
- Spasow and colleagues described in September 2000 a significantly improved tolerability of medication on patients with chronic hepatitis [43].
- Khotiainsev et al. described the effects of the electrophysiological efficiency of laser blood irradiation in acute coronary syndromes on 200 patients in 1996 with the conclusion that this therapy results in distinct positive changes of electrophysiological characteristics of the cardiovascular system with corresponding antiarrhythmic effects [20].

### 7.2 Results of the first pilot study 2004

Since the described method after reviewing the respective literature seems to have an astounding scientific interesting potency, we decided to reproduce at first the most remarkable results of the studies of Russian literature. The quoted study of Skvorcov et al. on treatment of chronic liver diseases [41] and the large-scaled studies of Kovalyova on treatment of diabetics with fat metabolism disorders [23, 24] were taken as a basis. For verification of the mentioned studies, in all 20 patients with diabetes mellitus and 15 patients with chronic liver diseases were included in a first pilot study in 2004



picture 6: Zertifiziertes Laserblutbestrahlungssystem mit biokompatiblem Einmalkatheter Quelle: M. Weber [48]

and had been treated according to the set Russian scheme with intravascular red light laser therapy (632 nm, 1,5 mW, 30 min) and transcutaneous irradiation of liver, pancreas, and spleen at the points Le 13 o.b.s., Le 14 right, and KG 12 with infrared laser (810 nm, 100 mW) for 20 minutes.

The intravascular examinations were made with the new type of laser blood irradiation system "weberneedle blood" of weber medical, Lauenförde (Germany) (picture 6) [48]. For the external irradiation we used the weberneedle-basic laserneedle acupuncture system with infrared laser needles.

Picture 12 shows the treatment of an allergy sufferer with intravascular laser blood irradiation combined with laserneedle acupuncture and external laser irradiation of ulcer cruris.

On the whole the described results of the Russian literature could be confirmed to a great extent. Actually there was a significant decrease of chronically increased liver and lipid parameters, but the reduction of LDL-cholesterol was significant above all. In individual cases a drop of pathological HbA1c counts was observed, but the validity of the figures is limited because the majority of diabetics had already been well adjusted.

On ethical grounds a preceding antidiabetic medication come off could not be justified. A maximum of improved laboratory parameters was observed as a rule only after six to twelve weeks.

Because of this characteristic course one could conclude that the postulated longterm cellular changes were modified at first and without any therapeutical measures, had an effect with temporal delay only. However immediate effects were observed, especially a tendency of hypoglycemia on stabil adjusted diabetics, that was already the evening after the first treatment.

**7.3 Treatment data 2005**

114 patients with a variety of clinical syndromes had been treated and evaluated in the year 2005 by the authors themselves. The treatments were carried through according to Russian instructions as combined treatments with laserneedle acupuncture. Partly it concerned patients who previously showed unsatisfactory results with acupuncture exclusively.

- fat metabolism disorders (n = 20)
- diabetes mellitus (n = 20)
- chronic pain syndrome (n = 12)
- rheumatoid arthritis (n = 5)
- polyneuropathies (n = 4)
- chronic-inflammatory diseases of the intestines (n = 5)
- fibromyalgia (n = 7)

- hypertension (n = 6)
- tinnitus (n = 3)
- diseases of the macula (n = 4)
- multiple sclerosis (n = 9)
- burn-out-syndrome (n = 9)
- allergies and eczema (n = 10)

The following effects could be verified by a questionnaire survey and the evaluation of clinical trials and laboratory parameters:

**General Effects**

- significant improvement of general fitness
- improvement of sleeping behaviour and vigilance
- positive effect on general prevailing mood
- reduction of consumption of medicine

**Special Effects**

- optimization of the condition of diabetic metabolism
- partial statin comparable influencing of hypercholesterinemia
- significant lowering of pathological increased liver counts
- reduction of phase rate in chronic-inflammatory diseases of the intestines
- improvement of general well-being and mobility with multiple sclerosis
- positive influencing of therapy resistant pain syndromes
- in some cases positive influencing of tinnitus
- reduction of antihypertensive medication in severe hypertension

Since its introduction and certification in March 2005 the laser blood

irradiation method became established in 90 more centres in Germany, Austria, Switzerland, Italy and Australia until the end of 2006. >From the amount of ordered disposable catheters one can find out that there were carried out approximately 100,000 treatments in the various centres because the catheter which is indispensable for the treatment is not available elsewhere.

A major poll was held at the end of 2006. On the occasion the following points should be considered:

- Acceptance by the patient
- Side effects
- Effects on the general state of health
- Presentation of special effects on the basis of case studies

This survey is a first major multicentre evaluation. A scientific evaluation of precise data can be made at a later time since the method is still new and many centres applied this therapy just in the course of 2006. After the evaluation of the questionnaires the above effects on the general state of health and general fitness and on the special effects of the provided case studies could be confirmed entirely. The acceptances from the patients was rated to be good by everyone, and there was no report on severe side effects. There are exceptionally interesting case studies that will be published later.



picture 7: Self-assessment of the patients regarding the fatigue-syndrome before and after therapy. Source: N. Schumm [39]



picture 8: Self-assessment of the patients regarding motorial and sensitive disorders before and after therapy. Source: N. Schumm [39]

#### 7.4 Results of a second pilot study 2006

The results of the first pilot study of the year 2004 were carried out as reported above according to the Russian scheme as a combined laser therapy i.e. as a combination of intravenous laser irradiation with transcutaneous liver-spleen-pancreas-irradiation. In order to verify the effects of laser blood irradiation alone without additional transcutaneous irradiation or rather acupuncture, 20 patients with diabetes mellitus, fat metabolism disorders and chronic liver diseases were treated in the practice of the authors once more with ten treatments each.

It turned out under laboratory supervision that blood irradiation as monotherapy did not provide specific results in the described diseases so that an additional transcutaneous laser irradiation (laser acupuncture) is given preference to achieve the best effects.

#### 7.5 Pilot study on multiple sclerosis

The neurologist Dr. N. Schumm from Hanover carried out a first pilot study in his practice on 16 multiple sclerosis patients in the year 2006 [39]. The patients were treated ten times on the whole only with red light laser (632 nm, 1,5 mW) of the Weber-needle-blood-device for 30 minutes each without any additional treatment.

For the evaluation of the general well-being and the sensomotorial disorders the so called EDSS (scale of significance of the handicap) was taken as a basis. On the whole an improvement turned out in 73 % of the chronic fatigue-syndrome (picture 7) and in 64 % an improvement of the sensomotorial disorders (picture 8). After years of experience of the neurologist Schumm with interferon therapy of multiple sclerosis, the effects have to put on a level with interferon therapy, but without any side effects.

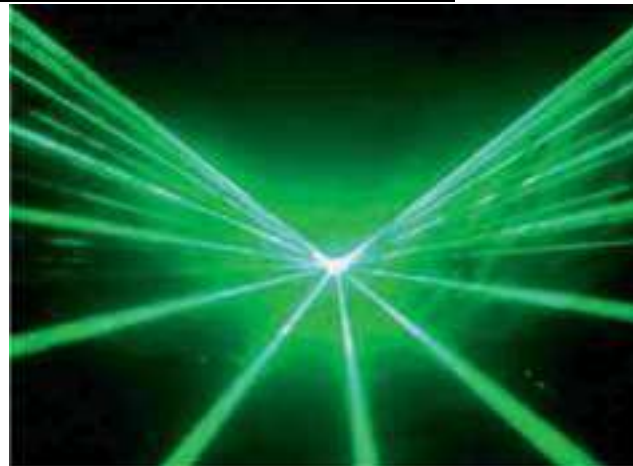
### 8. Innovations

#### 8.1 The new green laser in intravascular laser blood irradiation

Up to now it was believed that especially radiation in the red range was particularly

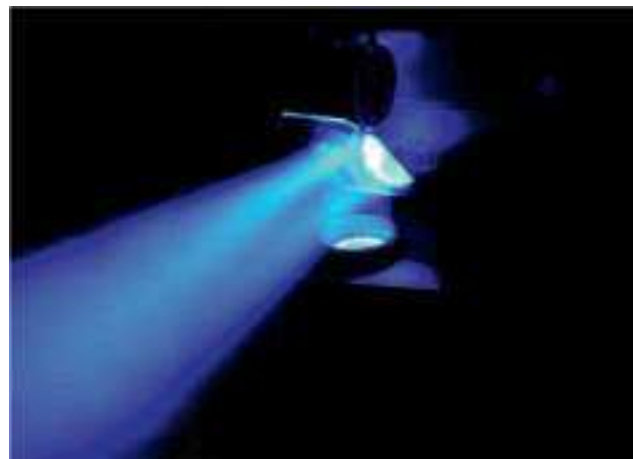
effective due to the absorption spectrum of cytochrome-C-oxidase in the respiratory chain, in this way with a very strong stimulation of the ATP-synthesis. The originally Russian studies were all carried out with red light laser of the wavelength 632,8 nm of the helium-neon-laser because in the beginning there was no laser in the shorter wave range (green or blue) at hand. When red laser light is conducted into the bloodstream, the vein lights up in bright red because the red light is not absorbed by the erythrocytes (picture 5). So actually it should make sense to use complementary green laser light for laser blood irradiation as well (picture 9). When green laser light is conducted into a vein you practically will not see any green shining through the skin since the "red" erythrocytes are absorbing green light virtually completely (picture 14) [38]. This therapy was introduced then by the author for the first time to laser blood irradiation and many of the patients treated with red laser light were treated with green laser once more, and the results were compared with red light laser. On that occasion it turned out that the green laser causes corresponding stimulations too and obviously reacts on various parameters in a different way or better than the red light laser. In a third cycle some of the patients were treated then with a combination of red and green laser - with the idea to stimulate the leucocytes initially with the red laser and to load with the green, predominantly the erythrocytes with energy. Then it turned out that the combination of both types of laser obviously reveal the best effect possible. These results represent however just first impressions and they have to be investigated further intensively to obtain valid data.

Reviewing the latest literature, really, the green laser was also tested in the irradiation of blood by other scientists recently. An article was published from MI et al. of Shanghai university in March 2004 [33] where blood cells were radiated in vitro with the wavelength 632,8 nm (helium-neon laser) and 532 nm (green laser). In these experiments it could be shown that the green laser had an advantage



picture 9: The green laser with a wavelength of 532 nm

of rheologic properties of the blood by an improved forming property of erythrocytes. The corresponding absorption spectrum for hemoglobin was assumed as cause for the green laser in particular. In a recent work of Kassak and colleagues of Bratislava university, Slovakia, in cooperation with the department General Biophysics of Lodz university, Poland [19], the effect of green laser light on Na-Ka-ATPase was investigated. A distinct stimulating effect of the green laser light on the activity of erythrocytic Ka-Na-ATPase was shown (picture 7). These latest findings are of exceptional significance. Previous explanatory models of the photobiochemical energy transfer model followed the mitochondrial structures and the electron carrier systems in the respiratory chain, but these are not existing in erythrocytes. According to previous ideas an absorption of green



picture 10: The blue laser with a wavelength of 405 nm



picture 11: Combined laser therapy with a diabetic patient with ulcer cruris source: Treatment case practice of the authors

laser photons to the erythrocytes would be only transferred into a local warming up. The evidence of an increased Na-K-ATPase permits the conclusion that besides the warming up also structural molecular changes are activated with triggering of specific biochemical activity. Especially in this continuity the membranous lipid layers can also change [19].

In another work from Vinck and colleagues of the department anatomy, embryology, histology of Ghent university, Belgium, it could be shown in April 2005 that under green light radiation it comes to an increase of fibroblast proliferation with an improved effect on glucose metabolism.

[47]. It must be emphasized here again that the described works on green laser so far were exclusively in-vitro-experiments. The first human investigations with green light laser blood irradiation were made by the authors themselves and have been described in this presented work here for the first time.

### 8.2 The blue laser in intravascular laser blood irradiation

The blue laser has a distinct absorption for porphyrins on account of its wavelength of 400-470 nm, consequently for hemoglobin too [49, 38].

So far there are only a few scientific data on clinical application with patients since it succeeded just a short time ago to build a solid blue semiconductor laser from galliumnitride (picture 10). It became public that caries, parodontitis and acne can be treated with blue LED (light-emitting diode) with good success because they are also emitting monochromatic light (but without deep-acting coherence) [50]. According to late researches *Helicobacter pylori* can be eradicated successfully by application of blue light over the gastroscope [14]. Cause of these effects is the bactericide effect of the blue monochromatic light that is binding to bacterial porphyrins and destroying them. Tiina Karu showed in several works that in the mitochondrial respiratory chain the red as well as the infrared laser light stimulates the last link of the respiratory chain the so called cytochrome-C-oxidase, while the first link the so called NADH-dehydrogenase has its absorption maximum in the blue range [18]. So there is that possibility to stimulate this "starter complex" carefully by radiating with blue laser. This effect will be of considerable importance for the intravenous laser blood irradiation. From the works of the Armenian laser scientist Levon Gasparyan the first data are available already [10]. He was able to show that under irradiation of the blood with blue laser light of low power (0,3 mW) the rheology of the blood will be significantly improved and as a result the microcirculation will improve too. According to the latest data collected by him also cases of tinnitus resistant to treatment



picture 12: Combined laser therapy with an allergic patient source: Treatment case practice of the authors

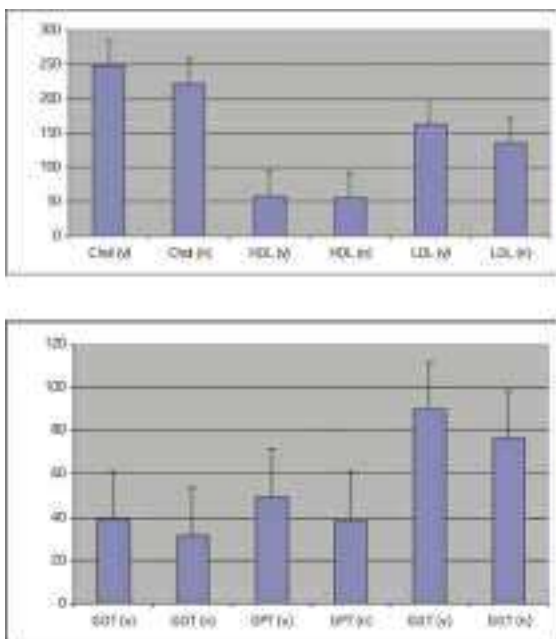
can be treated more successfully than before.

Furthermore it was reported that metabolism effects lead to a significant decrease of cholesterol, triglycerides and blood-glucose and bilirubin. The immunologic activity of the blood is increasing significantly according to Gasparyan [10]. Due to its proximity to the ultraviolet spectrum it is assumed that in the therapy of the blood the blue laser is also inducing the well-known immuno-stimulating effects as they are known from the UVB-treatment of the blood [8, 10].

In a work from October 2006 the blue laser was also used diagnostically to trace tumor cells. Due to strong absorption impulses of the blue laser cause melanoma-cells circulating in the blood to swing and to emit signals that can be recorded with highly sensitive microphones. This is called photoacoustic detection [49].

### 9. Side effects and risks of intravenous laser blood irradiation

There was no report up to now about any serious side effects of intravenous laser blood



picture 13: Results of the 1. Pilot study

irradiation. Considering the administered low power of 1-2 mW they are not to be expected. Laser acupuncture is a method, established over decades and virtually free of risk whereas also with this external therapy laser light is penetrating the body (with considerably higher power) and gets in contact with blood. The author has no reports on long-term injury lying in front of him. The above mentioned ultraviolet irradiation of the blood has been established for many years whereas the potential danger with the administered short wavelength in theory must be rated considerably higher.

In addition one can look back on a wealth of experience of about 30 years of use on a wide scale from Russia and other Eastern European countries where until today no serious side effects have been described too. Nevertheless a conforming enlightenment of the patient should take place with this method of treatment that is new in this country. The relevant legal aspects for the doctor responsible

for the treatment were worked on by Bodenburg extensively [2].

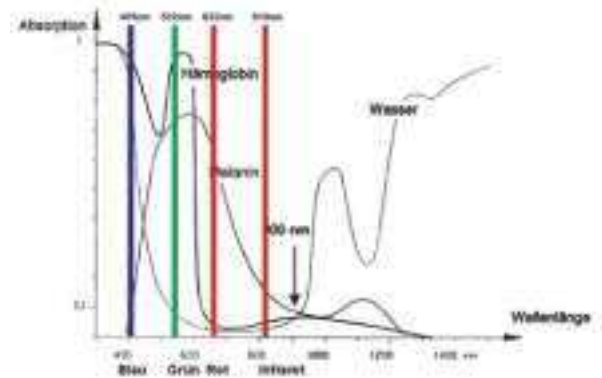
### 10. Discussion:

The various positive effects of intravenous laser blood irradiation that are described in literature could be affirmed to a large extent in the lead through pilot studies here.

But how the administered photon-energy reaches the particular organ-cells to set off the corresponding reaction, this is not finally settled until today.

Whether it is a matter of transfer of information of bio-photons or it concerns a transport of energy through other ways of metabolism with increased ATP-production at the end, needs an intensive scientific research in the next years.

In former explanation models the transfer of electrons is responsible for the separate steps in energy transport of the cell. Although there are in the respiratory



picture 14: Absorption diagram of laser light of different wavelength in biological tissues Source: modified n. Romber [38]

chain in the mitochondria various electron carriers included e.g. cytochrom-systems, flavine, Fe-S-complexes and others. One can measure typical absorption maxima for electromagnetic radiation for the various carrier-systems. At the absorption maxima the system can pick up the maximum electromagnetic energy

## Result

The new type of intravenous laser blood treatment presents a systemic form of (laser-) acupuncture. With the availability of an equivalent certified device there are possibly opening new ways in a successful alternative therapy of clinical syndromes that can be often treated with classical acupuncture only inadequately. These are especially diseases of the immune system and the liver as well as fat metabolism disorders and diabetes mellitus and their resulting complications as coronary heart disease and circulatory problems. The biological mechanisms are extremely complex and require further clinical researches and extensive basic studies. These researches could help to understand better the effects of photons in the organism.

and by that speed up the process of oxidative phosphorylation. For further research the calculated use of specific wavelengths that orientate towards the absorption maxima of the divers biochemical structure should be of fundamental importance. This way stimulation or as well inhibition of enzymes and the metabolism ways catalysed by them could be influenced.

## 11. Conclusion:

The described connections and results of intravascular laser irradiation method promise for the future an abundance of additional facts. It is interesting that here new ways open up in the treatment of common diseases. Especially diabetes mellitus, chronic hepatitis, cirrhotic liver and toxic liver diseases, cardiovascular diseases and autoimmune diseases including allergies must be emphasized. But the range of means of treatment should not be exhausted with that. The described immunological activation possibly opens also new therapeutical approaches in the adjuvant tumor therapy. Extensive studies will be essential in the future to explore the potential of means of treatment and find an answer to the fundamental questions of mechanism of effect.

The possibility of treatments with laser light of

different wavelength (red, green, infrared and blue) and the setting of various laser frequencies open more distinguished strategies of treatment and a new field of research that is not assessable.

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