M. H. Weber

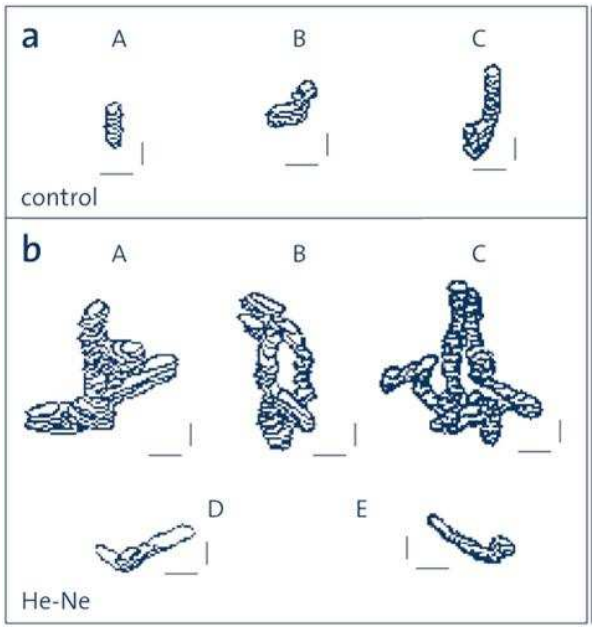
The intravenous laser blood irradiation - Introduction of a New Therapy

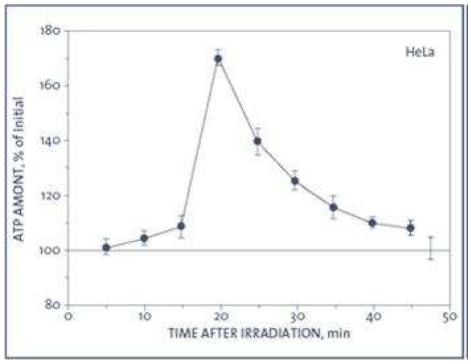
1. Introduction

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 [32]. Originally this method was developed for the treatment of cardiovascular diseases. Improvement of rheologic properties of the blood as well as improvement of microcirculation and reduction of the area of infarction had been proved. Further reductions of dysrhythmia and sudden cardiac death occured [4,21]. 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. The studies were published mainly in Russian which were little known in the West because of decades of political separation, and were regarded 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". [19].

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

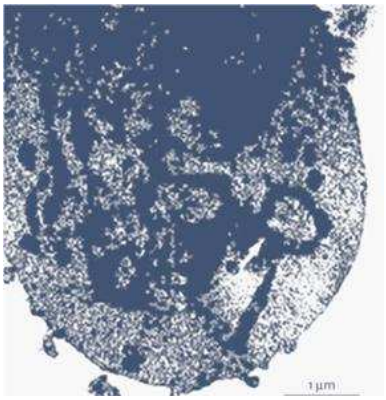
1. Under laser blood irradiation anti-inflammatory effects were observed that improved the immunologic activity of the blood.
2. A fundamental finding was the positive influence on rheological properties of the blood which is of greatest interest to surgery, angiology and cardiology in particular [50]. A diminishing tendency of aggregation of thrombocytes and an improved deformability of erythrocytes result in an improved oxygen supply and with that to a decrease of partial which is particularly relevant to wound healing [10, 27, 59]. Furthermore the activation of phagocytic activity of macrophages was proved in conjunction with structural modifications [8, 22]. A positive effect on the proliferation of lymphocytes and B- and T-cell-subpopulations could be verified too [13, 50, 38].





picture 2: Increase of ATP with laser-irradiation (632 nm) of HeLa-cell culture source: Karu [19]

3. The hypoxia of the tissue will be improved which leads to a normalization of the tissue metabolism. In addition the fibrinolysis will be activated [35]. Apart from the elimination of hypoxia and the normalization of tissue metabolism an increase of ATP-synthesis will occur with a normalization of cell membrane potential. [44]. Additional vasodilatation is leading to de-blocking of capillaries and collateral vessels in connection with the described improved rheological properties of the blood together with an improved trophicity of tissues and normalization of neurosensory stimulation. The increased release of NO from monocytes obviously is of critical importance [29].
   Because of the described effects the intravascular blood-irradiation is used in Russian surgical university-clinics pre-operatively to avoid thromboembolic complications, and improve postoperative woundhealing[12,27].
   In addition there are laser specific analgetic, spasmolytic and sedative effects [14] There are reports on patients with chronic glomerulonephritis who had significant improvement of tolerability of medication (glucocorticoids, cytostatic drugs, diuretics) and of kidney function [30],.
   In the same way an improvement of inflammation parameters in acute pyelonephritis could be shown [7]. In necrotising pancreatitis an improvement of blood lab values and of the immunological parameters had been proved too.
4. Intravenous blood irradiation was widely used in obstetrics and gynecology to stimulate utero-placental blood exchange and as a prophylaxis and therapy of inflammations of the interior genitals [11].



picture 3: Ringshaped „Giant mitochondria" of irradiated human leucocytes with helium-neon-laser 632 nm
source: Manteifel et al. [32]

5. Furthermore it was observed that mitochondria changed to so called "giant mitochondria" (picture 1) after laser-irradiation with activation of various metabolic pathways and increased production of ATP [31] (picture 2). The electron microscopy of “giant mitochondria” revealed intracellular annular ("ring-shaped") structures (picture 1 and 3). These mitochondrial changes cannot be compared with pathological giant mitochondria as they appear in certain clinical syndromes. In these syndromes we can observe pathological swelling of the organelles and deposit of pathological paracrystalline albumins leading to specific myopathies [47].

The structure of mitochondria may vary strongly according to the type of cell. They can impress as sausage shaped organelles, but may also appear as a highly branched intercommunicating tubular network. Observations of fluorescence marked mitochondria in living 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 themselves. Probably the balance between fusion and division is decisive for the shape and form of a mitochondrion [18]. It was shown in histological researches on helium-neon laser irradiated lymphocytes that by 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 [2, 31]. Manteifel and Karu proved big branched forms of mitochondria in germinating yeast cells, but after laser-irradiation an expansion of the tubular network developed without damaging the organelles [32]. These mitochondria are marked by a relative enlargement of surface of the mitochondrial cristae due to activation of the respiratory chain and ATP-synthesis. It has to be mentioned that the description of the development of mitochondria to giant mitochondria is discussed controversially. Heine (reviewer of this article) is pointing out that there is no evidence that such pathological forms of mitochondria will lead to an activation of varied metabolic pathways ways leading to an increase of ATP-production. Heine described 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 [17]. 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 deseases causally or additively. Gasparyan described the improvement of microcirculation especially in central nervous structures. In particular, this is most imprtant in the hypothalamus which has a highly developed vascular micro system. He assumes that the intravenous blood-irradiation is stimulating the functional activity of the hypothalamus and limbic system leading to an activation of hormonal, metabolic, immunological and vegetative processes with mobilization of adaptive reserves [11].

TABLE 1 ***Described effects of intravascular laser blood-irradiation***

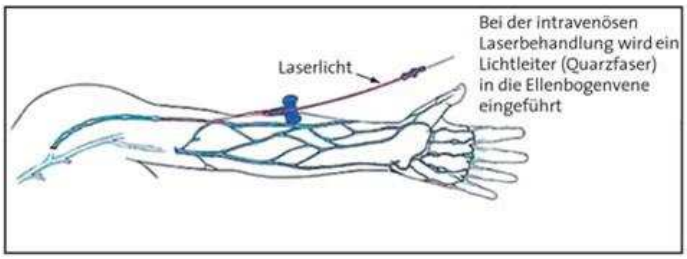
Stimulation of immune response, specific and non-specific
Increase of the immunoglobulines IgG, IgM and IgA
Stimulation of interferons, interleukins and TNF-alpha
Stimulation of the proliferation of lymphocytes
Increase of phagocytic activity of macrophages
Lowering of CRP
Improvement of the anti-oxidant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

3. Comparison of intravenous laser with ultraviolet irradiation 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 substances are added and after UV-C-irradiation led back to the body by reinfusion (UVB-therapy).
In haematogenous oxidation-therapy (HOT) the blood is frothed with oxygen additionally before it will be irradiated with ultraviolet light [9]. As a result there are various positive effects, very similar to the effects of 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 out 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 considered 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 [19], calculated biological effects can be set off with defined wavelengths in the catalytic centers of these structures. It is a known fact that e.g. the cytochrome-C-oxidase-complex as the final part 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.
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 the visible and near infrared spectrum.

4. The consideration of intravenous laser blood-irradiation as "blood-acupuncture" by dissolving of blood stasis

In Chinese Medicine the term "Xue" is of great importance. It comprises the most important 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 can be said: Blood cannot flow without Qi, Qi cannot be held without blood [61]. Stagnation of blood and Qi are called blood-stasis-syndrome [37]. 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 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.



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

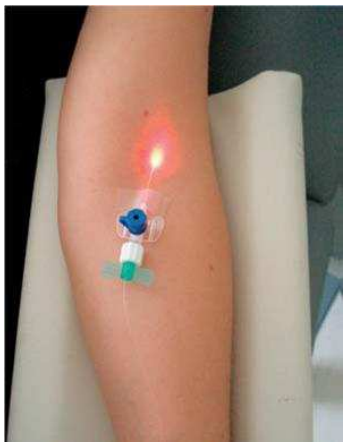
5. The relationship of intravenous laser blood-irradiation with the system of basis-regulation according to Pischinger and Heine as well as on physiological leucocytolysis

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 capillaries (the “end stream”), basic substance (extra cellular matrix [ECM]) and cells. The extra cellular 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 entral nervous system 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 proteoglycanes, glucosaminoglycanes, 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 extra cellular 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 anti-aging-therapy, in particular when combined with additional useful methods 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 extra cellular matrix. The ability of leucocytes to physiological lyses 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 [16]. 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: Practical application of Intravenous Laser Blood Irradiation

Intravenous laser blood irradiation is carried out with low power of 1-3 mW and an exposure time of 20-60 minutes. A series of 10 treatments will be carried out either every day or three times a week with a weekend break.

For intravenous laser blood irradiation first of all you have to feed in a cannula into a suitable vein of the elbow or the forearm. The vein should have a wide lumen to catch a great volume of blood 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 plastic cannula for children (Braun Medical, Melsungen) into a suitable vein and then a newly developed disposable laser-catheter made of biological compatible plastic material is inserted into the vein (picture 5).



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

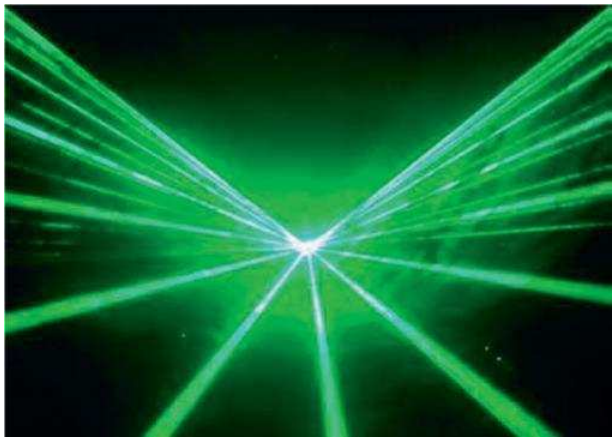
With veins that are difficult to puncture or if there is lack of practice, the setting of the cannula may cause problems, but recently a suitable little butterfly was developed which permits an easy application of the above described catheter. The advantage of this therapy is that it can be learned by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

7. Innovations

7.1 The new green laser in intravascular laser blood irradiation

Up to now it was believed that especially irradiation in the red range was particularly effective due to the absorption spectrum of cytochrome-C-oxidase in the respiratory chain with a 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) available. 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) [41]. This therapy was introduced 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 energy on the erythrocytes with the green laser. Then it turned out that the combination of both types of laser obviously reveal the best possible effect. 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 [34] where blood cells were irradiated 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 on rheologic properties of the blood by an improved deformibility of erythrocytes. The corresponding absorption spectrum for hemoglobin was assumed as cause for the green laser effect in particular. In a recent work of Kassak and colleagues of Bratislawa university, Slovakia, in cooperation with the department of General Biophysics of Lodz university, Poland [20], the effect of green laser light on Na-Ka-ATPase was investigated. A distinct stimulating effect of the green laser light on the acivity of the erythrocyte 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 laser photons to the erythrocytes would be only transferred into a local warming up. The evidence of an increased Na-Ka-ATPase permits the conclusion that besides the warming up also structural molecular changes are activated with triggering of specific biochemical activity. So the membraneous lipid layers can also change [20]. In another work from Vinck and colleagues of the department anatomy, embryology and histology of the Universiry of Ghent, Belgium, it could be shown in April 2005 that under green light irradiation it comes to an increase of fibroblast proliferation with an improved effect on glucose metabolism [52]. 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 author himself and have been described in this presented work here for the first time.

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



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

7.2 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, so consequently for hemoglobin too [54, 41]. So far there are only a few scientific data of 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, periodontosis 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) [55]. According to late researches Helicobacter pylori can be eradicated successfully by application of blue light over the gastroscope [15]. Cause of these effects is the bactericide effect of the blue monochromatic light that is binding to bacterial porphyrins and destroying them by release of reactive oxygene radicals. Tiina Karu showed in several works that in the mitochondrial respiratory chain the red as well as the infrared laser light stimulates the last complex of the respiratory chain, the so called cytochrome-C-oxidase, while the first complex, the so called NADH-dehydrogenase, has its absorption maximum in the blue range [19]. So it is possible to stimulate this "starter complex" by irradiating 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 already available [11]. 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 other therapies 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 [11]. 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 immunostimulating effects as they are known from the UVB-treatment of the blood [9, 11]. 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 circulating melanoma-cells in the blood to swing and to emit signals that can be recorded with highly sensitive microphones. This is called photoacoustic detection [54].

8. Clinical studies:

8.1 The Results of eastern studies

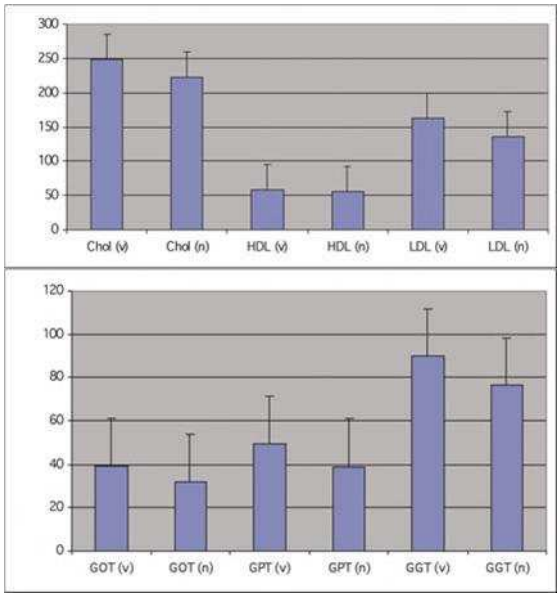
An extensive study of the Academy of Medicine Wolgograd on 175 patients with chronic liver diseases, including forms of chronic hepatitis and cirrhotic liver was published in German translation, 2002 [47]. After a series of 10 treatments with 630nm 1mW red light laser for *40* min a significant improvement of the antioxidant enzyme system and a long lasting significant reduction of pathological increased liver parameters were achieved. In 2002 several most interesting articles on the influence of long term complications and fat metabolism disorders connected with diabetes mellitus, were published by the Russian doctor Tatjana Kovalyova (Department, 2. Municipal Clinic Izhevk, Russia) translated by Prof. Marti, Institut für LLLT & Naturheilkunde, Thun/Switzerland [24, *25*]. The patients were treated in three series with 10 sessions every day over a span of six months.
This therapy was performed as so called combined laser therapy, that means besides the intravenous laser-application additionally the regions of liver, pancreas and spleen were irradiated transcutaneously. An almost statin-equivalent reduction of lipid parameters was described as well as a significant reduction of various typical diabetic complications such as retinopathies and angiopathies [24]. D. Siposan and colleagues of the 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 [44].
Even an improvement of the life-threatening situation of hemorrhagic shock could be shown in a study by Kozura and colleagues in 1993 [26]. Spasow and colleagues described in September 2000 a significantly improved tolerability of medication on patients with chronic hepatitis [48]. 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 [21].

8.2 Results of the first own pilot study 2004

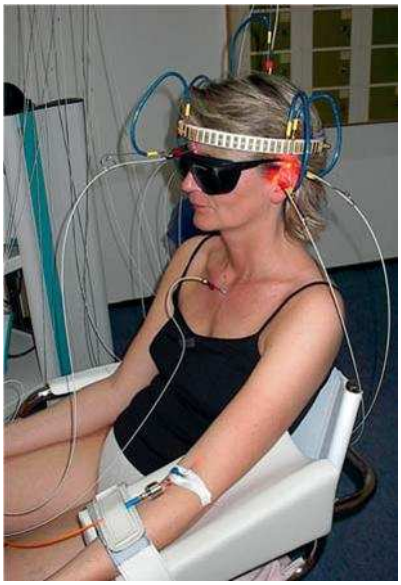
Since the described method after reviewing the available literature seems to have an astounding scientifically interesting potency, the author decided to reproduce at first the most remarkable results of the studies of the Russian literature. The quoted study of Skvorcov et al. on treatment of chronic liver diseases [46] and the large-scaled studies of Kovalyova on treatment of diabetics with fat metabolism disorders [24, *25*] were taken as a basis. For verification of the mentioned studies, 20 patients with diabetes mellitus and 15 patients with chronic liver diseases were included in a first pilot study in 2004 and were treated according to the Russian schedule with intravascular red light laser therapy (632 nm, 1,5 mW, 30 min) and transcutaneous irradiation of liver, pancreas, and spleen at the points Lv 13, Lv 14 right side, and CV 12 with infrared laser (810 nm, 100 mW) for 20 minutes.

The intravascular treatments were carried out with the new type of laser blood irradiation system "weberneedle blood" of weber medical, Lauenförde (Germany) (picture 6) [53]. For the external irradiation the weberneedle-basic laserneedle acupuncture system with infrared laser needles was used.

picture 6: Zertifiziertes Laserblutbestrahlungssystem mit biokompatiblem Einmalkatheter Quelle: M. Weber [53]



picture 13: Results of the 1. Pilot study 2004



Picture 12: Combined laser therapy in an allergic patient
Source: Treatment case practice of the authors

Picture 11: Combined laser therapy in a diabetic patient with ulcus cruris
Source: Treatment case practice of the author

Picture 12 shows the treatment of a patient suffering of severe allergy with intravascular laser blood irradiation combined with laserneedle acupuncture.

Picture 11 demonstrates the treatment of a diabetic patient with intravenous laser therapy and external laser irradiation of an ulcus cruris.

On the whole the described results of the Russian literature could be confirmed. 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 values was observed, but the validity of the figures is limited because the majority of diabetics were already been well adjusted. On ethical grounds a discontinuation of a preceding antidiabetic medication could not be justified. A maximum of improved laboratory parameters was observed as a rule mostly after six to twelve weeks. Because of this characteristic course one could conclude that the postulated long term cellular changes were modified at first and without any therapeutical procedures, had an effect with temporary delay only. However immediate effects were observed, especially a tendency of hypoglycemia on stabile adjusted diabetics.

8.3 Own Treatment data 2005

114 patients with a variety of clinical syndromes had been treated and evaluated in the year 2005 by the author himself. The treatments were carried out 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 bowel diseases (n = 5)
- fibromyalgia (n = 7)
- hypertension (n = 6)
- tinnitus (n = 3)
- macular degeneration (n = *4)*
- multiple sclerosis (n = 9)
- burn-out-syndrome (n = 9)
- allergies and eczemas (n = 10)

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

General Effects

- significant improvement of general fitness
- improvement of sleeping behaviour and vigilance
- positive effect on general mood
- reduction of drug consumptionSpecial Effects

- optimization of diabetic metabolism
- partially statin comparable influence on hypercholesterinemia
- significant lowering of pathological increased liver values
- reduction of relapse in chronic-inflammatory bowel diseases
- improvement of general well-being and mobility in multiple sclerosis
- positive influence on therapy-resistant pain syndromes
- in some cases positive influencing of tinnitus (ringing in the ear)
- reduction of antihypertensive medication in severe hypertension

Since its introduction and certification in March 2005 the laser blood irradiation method was established in more than 300 centers 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 centers because the disposable catheter 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 was a first major multicenter evaluation. A scientific evaluation of precise data will be made at a later time since the method is still new and many centers 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 were 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.

8.4 Results of a second own pilot study 2006

The results of the first pilot study of the year 2004 were carried out as reported above according to the Russian schedule 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 acupuncture, 20 patients with diabetes mellitus, fat metabolism disorders and chronic liver diseases were treated in the practice of the author once more with ten treatments each.
It turned out under laboratory supervision that blood irradiation as mono therapy did not provide comparable specific results in the described diseases so that an additional transcutaneous laser irradiation (laser acupuncture) is given preference to achieve the best effects.

8.5 Studies on Multiple Sclerosis

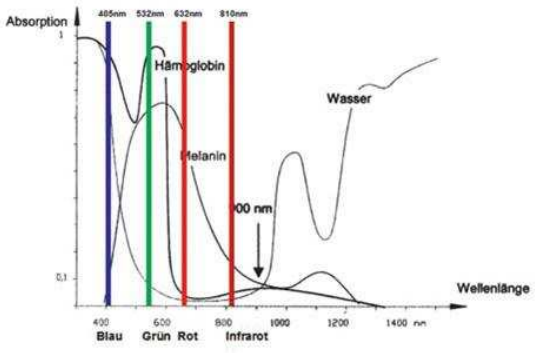
Multiple sclerosis (MS) is an isolated central nervous system disorder of unclear origin. Initially inflammatory processes predominate, degenerative developments ensue during the following progress. Disturbances of the motor and sensitive system come to the fore of symptomatology, culminating in restrictions of visual capacity due to inflammatory processes of the central nervous system. A massive chronic exhaustion subsequently often ensues, which may cause inability to work and for which no effective therapy is known. Concordance with the HLA system is known, affecting the autoimmune and inflammatory processes. In terms of aetiology, an autoimmune, neurodegenerative and inflammatory origin is discussed.
The current prevailing doctrine assumes that a T-cell-dependent disorder with initial secondary macrophage activity and myelin sheath destruction is concerned. An immunosuppressive treatment is normally carried out nowadays.

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 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 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 out by the lawyer Bodenburg extensively. In spite of an international CE-certification it is recommended to explain this new therapy thoroughly to the patient and if he agrees he should sign a document for informed consent. The juristic aspects are explained and discussed in the publication of Bodenburg [3].

10. Discussion:

The various positive effects of intravenous laser blood irradiation that are described in the literature could be affirmed to a large extent by the author and described pilot studies. But how the administered photon-energy reaches the particular organ-cells is not finally clear 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. There are various electron carriers in the mitochondria like cytochrom-systems, flavins, Fe-S-complexes and others. One can measure typical absorption maxima for electromagnetic radiation for the various carrier-systems. At the absorption maximum the system can pick up the maximum electromagnetic energy 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 structures should be of fundamental importance. By this way stimulation or inhibition of enzymes of the metabolic pathways can be investigated.



Picture 14: Absorption diagram of laser light of different wavelenght in biological tissues Source: modified from Romberg [41]

The new type of intravenous laser blood treatment presents a systemic form of (laser-) acupuncture. With the availability of an equivalent certified device we have now a new way of successful alternative therapy of clinical syndromes which can be 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.

11. Conclusion:

The described connections and results of the 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 leaver diseases, cardiovascular diseases and autoimmune diseases including allergies must be emphasized. But the range of means of treatment should not be limited 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 wavelengths (red, green, infrared, blue and yellow) 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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