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Haemo-Laser® Therapy

Basic principles, mode of action, clinical outcomes

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LASERTHERAPIE UND FRAKTALE MEDIZIN

Development of Laser Therapy

Experimental investigations of the biological effect of low-energy laser light were already taking place in the 1970s in Russia, primarily in Alma Ata in Kazakhstan.

Roughly 25 years ago, the laser finally entered the field of acupuncture with initial attempts to stimulate acupuncture points using low-energy laser light (5 to 20 mW) with wavelengths in the red or adjacent infra-red range. It is also generally known that the laser can be used in diverse dermatological indications; here too, laser light exclusively from the red or infra-red region is used. The effect of the red-light laser or infra-red laser with the above power density on acupuncture points and in local irradiation in dermatology has been confirmed by numerous studies and is widely used in clinical practice. In accordance with the mechanism of action, the method is free of side-effects.

Diverse in vitro studies over the last 25 years at different research centres, including the Atominstitut der österreichischen Universitäten ("Atomic Institute of the Austrian Universities") in Vienna (Prof. Herbert Klima), have demonstrated an effect on the red and the white blood systems. A bactericidal and viricidal effect was also documented. The influencing and acceleration of wound healing could be impressively demonstrated, primarily by Mester et al. (Budapest).

IV Irradiation

Approximately 20 years ago in various Russian research centres, initial experiments were performed using direct irradiation of blood with the low-level laser. Red-light lasers in the approximate range 600 to 670 nanometer were preferably used.

In the meantime, numerous investigations and studies have enabled a relatively clear picture to be made of the effect and outcome of irradiating blood. Because this therapy is free of side-effects and because of the extremely positive clinical outcomes, intravenous blood irradiation with low-level laser has become an established part of clinical practice in Russia and various Asian countries.

Equipment

The light sources used are therapy lasers which are manufactured by the company Heltschl and which have proved their worth both in the local irradiation of dermatological diseases and for the stimulation of acupuncture points with laser light. These are diode lasers which emit a wavelength of approx. 670 nanometer and have a power output from 50 to 100 mW. The light source is coupled to an adapter, which functions as an optical wave guide and is itself connected to a single-use optical wave guide that is inserted into the vein.

This consists essentially of an approximately 15 cm long synthetic fibre, which is inserted via a cannula directly into the vein – preferably into the cubital vein. The design of the adapter and the single-use optical waveguide is such as to prevent any contamination of the adapter with the patient's blood. The light-guiding adapter is constructed such that the amount of light energy flowing through it can be calibrated to deliver the required power of 1 to 4 mW at the end of the single-use optical waveguide. This is the energy density which, on the basis of the many clinical studies, can be expected to provide an optimal therapeutic effect.

Previous use of haemo-laser therapy (intravenous laser blood irradiation)

Intravenous laser therapy (haemo-laser therapy) is already being used routinely in a whole series of diseases at different health centres in Russia. The treatment is basically suitable for all diseases associated with a state of energetic debility or limited metabolic functions. These include chronic pain syndrome, diabetes mellitus, metabolic diseases, chronic liver diseases autoimmune diseases, lung function disturbances and allergies – and this list of indications is by no means complete. The indications listed have been the subject of extensive studies which on account of the study design, experience, and the numbers of patients can be evaluated as absolutely high-quality. Knowledge of these studies is only very sketchy in the West because, first, they are written in Russian (apart from the abstracts) and, second, the economic situation arising from social and political developments in Russia during the last 15 years have considerably hindered the internationalisation of Russian science.

Nevertheless, the European Forum for Laser Therapy and Fractal Medicine has for many years been in close contact with leading Russian scientists and physicians working in this field. Mention can be made of Professor Timna Karu from Moscow and Dr. Tatjana Kovaleva, who currently manages her own laser institute in Moscow and has published work on laser therapy in diabetes and hyperlipidaemia, and on the treatment of cardiac and renal insufficiency.

Use of intravenous laser in the West

Since 2004, intravenous blood irradiation with the low-level laser has also been performed in the West. For this purpose a therapy device was developed in Germany which conforms to the therapy regimen described above.

This device is certified and is approved for clinical use.

BASIC PHOTOBIOLOGICAL PRINCIPLES

Introduction

That biophysical parameters such as light affect biological systems has been known for a long time. Just one example is the successful use of UV irradiation of blood since the 1930s in Germany, Russia and the USA. Especially in the USA, this method has been used with success in over 800,000 patients, for example in viral hepatitis. This irradiation of the blood takes place outside the body and the irradiated blood is then re-injected. In the 1970s, transcutaneous irradiation of blood was performed using the newly available laser light. This was possible because light in the red wavelength range is also taken up transdermally to a limited extent. This is not the case for blue or green light since these wavelengths are absorbed in the skin region.

Intravenous irradiation of blood

An injection cannula containing a synthetic fibre is inserted into the elbow vein. The vein used should preferably have a lumen of between 4 and 6 mm diameter. This fibre has a diameter of approx. 0.5 mm and is placed in the vessel in a sterile manner through a conventional cannula. This single-use fibre is coupled to a light-guiding adapter, which is connected in turn to the laser source. The laser power of this red light laser (at the intravasal end of the single-use light guide) is 1 – 4 milliwatt, the power density is 5 watt/cm2, the energy density is 12,000 joule/cm2 and the irradiation time is between 20 and 25 minutes. The calculated radiation energy for an irradiation time of 25 min is approximately 3 to 3.5 joule, which corresponds exactly with the usual energy density for low-level laser therapy.

Haemo-laser therapy is the embodiment of a regulation therapy. This means that, on the one hand, this therapy cannot influence healthy tissue in any way whatever and, on the other, that disturbed cell functions are stabilised by the laser light. This leads to the normalisation and optimisation of cell metabolism. It also explains why none of the previous clinical and scientific investigations have detected any side-effects. This is why the Russian ministry of health had already approved this method in all clinics and hospitals in 1984. The therapy has also achieved outstanding success in veterinary medicine and has been approved in this field in Russia since 1988.

The following gives an overview of the microscopic, photobiological and biochemical effects of blood irradiation in erythrocytes, thrombocytes, leukocytes and blood plasma (inter alia from [5])

In erythrocytes:

- changes of hydrophobic-hydrophilic interactions in the membrane,
- normalisation of the degree of peroxidation of membranous lipids,
- demasking of membranous receptors, and increase in their ligand-binding capability;

- increase in the 02-binding capability;

- increase in deformability;

- decrease in aggregation;

- decrease in blood viscosity determined by erythrocytes

In platelets:

short-time rise in adhesive properties,

increase in aggregational activity with subsequent deaggregation,

In leukocytes:

- structural changes of supramembranous components and their shedding,

- demasking and increase of the expression of membranous markers,

- activation of phagocytosis in monocytes and granulocytes, with release of bactericidal Proteins;

- modulation of lymphocyte blastogenesis;

- stimulation of the NK-cell cytotoxic activity;

- Modulation of the IL-1 ß secretion and TNF-a secretion,

In plasma:

- increase in the albumin binding capability;

- change of degree of lipid peroxidation;

- stimulation of antioxidant activity,

- activation of 1gM and complement,

- increase in the growth-stimulating activity;

- appearance of ability to increase repair of DNA damages in lymphocytes

Photobiological effect on the erythrocytes

Since the erythrocytes make up by far the largest fraction of blood, their surface structure also exerts the strongest influence on the flow behaviour of the blood. Considering that with a diameter of only 7 micrometre they are roughly twice as thick as the thinnest capillary, their outer membrane must be extremely elastic in order that they can be forced through these finest vessels. Like every other cell membrane, this outer membrane is a lipid double layer which is very sensitive towards oxidative attack. The resulting lipid peroxidation that occurs (radical formation!) is a chain reaction that severely damages the membrane, causing it to lose its elastic deformability. Since a chain reaction of this kind can be stopped only with antioxidants, erythrocytes are well equipped with antioxidative enzymes (superoxide dismutase, glutathione peroxidase, etc.) and substances (e.g. glutathione, vitamins).

Unlike normal body cells, erythrocytes do not have a cell nucleus and therefore also lack the means to synthesise protein. They must rely on anaerobic glycolysis to generate energy, with glucose as the main substrate. In addition to the ATP so formed, which is needed in particular for active zone transport through the erthrocyte membrane in order to maintain the intra-extracellular ion concentration gradients (and therefore the shape of the erythrocytes via the colloid osmotic pressure), reducing substances are produced such as NADH and, in the pentose phosphate cycle, NADPH.

Among other functions, NADH is needed for the reduction of the constantly produced methaemoglobin to 0_2-transport capable haemoglobin; NADPH is needed for the reduction or regeneration of the glutathione present in the erythrocytes. Thus the easily oxidisable glutathione protects important enzymes with SH groups inside the cell (e.g. the haemoglobin molecule) and, as mentioned above, the membrane. In this way, the superoxide radical 0_2• generated by lipid peroxidation is first reduced by the enzyme superoxide dismutase to H_20_2 and this is reduced to water by glutathione peroxidase with glutathione as cofactor. The glutathione disulfide that is produced as a result is reduced back to glutathione with NADPH and the enzyme glutathione reductase [2,3].

The changed structure and function of the erythrocyte membrane as a result of blood irradiation is accompanied by an improvement in the ligand binding capability of the erythrocyte receptors. This, in turn, effects an improved transport and detoxification function of the blood. This has been confirmed by measurements showing a threefold improvement in the purification of the serum from anti-rhesus antibodies by the erythrocytes. [4]

Effect on the rheological properties of the blood

The above structural changes to the erythrocyte membrane induced by blood irradiation comprise the main effect of this blood irradiation on the erythrocytes. The following changes are already observable 30 to 60 minutes after an irradiation:

- a **10% increase** in erythrocyte deformability
- a **28% decrease** in erythrocyte aggregation
- a **72% increase** in the deformability of the extracellular “cloud” (boundary layer between cell and blood plasma) and
- **a 40% decrease** in blood viscosity.

But no kind of damage to or destruction of erythrocytes. Since both the viscosity of the blood plasma and the haematocrit remain constant during these measurements, the decrease in total blood viscosity must result from an improvement in the rheological properties of the erythrocytes.

The changes in the erythrocyte properties are still reversible between the first few irradiations, but after approximately the 4th irradiation they achieve the above final values. It is interesting that these changes in the rheological properties of blood in the above in vitro experiments occur only in the presence of thrombocytes.

Many diseases, especially those involving inflammation and increased tissue breakdown, are associated with an increased sedimentation rate. The main cause of this is the increased tendency of the erythrocytes to clump together and form larger aggregates. Because of their smaller surface area to volume ratio, the flow resistance of these agglomerates is lower and they sink faster than the corresponding number of single cells of the same total volume.

The size and shape of the erythrocyte agglomerates depend on the equilibrium between four forces: the gravitation between large molecules in the erythrocyte surfaces, the electrostatic repulsion of the negatively charged erythrocyte surfaces, the hydrogen bonds between the erythrocytes, and the flow shear forces. In many diseases the surface charge is reduced and this equilibrium is disturbed. The attractive forces of gravitation and hydrogen bonding are greater than the repulsive electrostatic forces and flow shear forces. Erythrocyte agglomerates form and consequently both the blood viscosity and the sedimentation rate increase.

As a result of quantum physical interactions, the photons of the laser light source are able to break the hydrogen bonds and so restore the original equilibrium between attractive and repulsive forces. The erythrocyte agglomerates break down, the blood viscosity and sedimentation rate fall, and the microcirculation improves.

Translation mechanisms

The "signal transfer" that occurs during blood irradiation from the irradiated blood to the entirety of circulating blood takes place essentially via thrombocytes and mononuclear cells.

Irradiated thrombocytes exert the following effects:

- changes in the lipid peroxidation in the erythrocyte membrane
- improvement in the rheological parameters of the blood
- modulation of the growth stimulation of body cells such as fibroblasts
- stimulation of DNA repair ("photoreactivation") after radiation damage.

Irradiated mononuclear cells exert the following effects:

- activation of the phagocytosis by granulocytes and monocytes
- modulation of the blastogenesis of lymphocytes and
- stimulation of the colony forming of bone cells and fibroblasts.

Even irradiated blood plasma is sufficient to amplify the expression of membrane markers on mononuclear cells.

Effect of blood irradiation on thrombocytes

Many publications have appeared dealing with this topic. More careful perusal reveals that the effect is very dependent on the power densities and energy densities used. Low energy densities (approx. 1 joule/cm^2) lead to a reduction in thrombocyte aggregation as a result of the decrease in the expression of the adhesion protein P-selectin and a weaker binding capability of fibrinogen at GPIIIa/IIb receptors. Furthermore, adhesion is diminished at the extracellular matrix, the collagen networked surface and the vascular endothelium. At this point it should be mentioned once again that thrombocytes – in contrast to erythrocytes – possess mitochondria whose oxidative metabolism can be stimulated by light, especially in the red and blue wavelength region. This regulates the Ca2+ ion concentration that controls almost every important process in the human body.

Effect on leukocytes and blood plasma

Blood irradiation leads to a decrease in the pro-inflammatory cytokines and an increase in the anti-inflammatory cytokines.

Irradiation with laser light exerts an influence on the respiratory chain in the mitochondria of the cells and leads to the stabilisation, normalisation and optimisation of cell metabolism (increased ATP synthesis). In neutrophilic granulocytes and monocytes, metabolic rate and phagocytic activity are strengthened.

CLINICAL OUTCOMES

A German-language research paper published in 2002 documents the biostimulatory and therapeutic effects of red laser light in various liver diseases, some of them severe.

The diseases included cirrhosis of the liver, diverse forms of hepatitis (chronic active and chronic recrudescent), whereby the chronic cases of hepatitis and cirrhosis of the liver were caused by viruses B and C and by excessive consumption of alcohol. In addition to exact clinical observation, Sulem and thymol probes, bilirubin, the protein spectrum of the blood, enzymes whose presence in blood indicates damaged liver cells, alanine and asparagine transaminases, and liver-specific enzymes such as urokinase, histidase, and fructose monophosphate aldolase were investigated.

The course of therapy comprised five to seven sessions which were performed with a radiation power of 1 mW for a duration of 40 – 60 minutes daily. The wavelength used for the irradiation was 630 nanometer.

After the therapeutic laser irradiation, the following positive changes were observed: a significant lowering of the lipid peroxidase level and enzyme activation of the antioxidant protection was found for 60% of the patients with aggressive hepatitis, for 45% of the patients with cirrhosis of the liver, for 77% of the patients with less active hepatitis, and for 80% of the patients with recrudescent hepatitis. In the case of aggressive hepatitis the malonyl aldehyde level fell to 34.9% and the conjugate concentration to 12.2%, the catalase activity increased to 23.5%, the superoxide dismutase to 39.8% and the glutathione peroxidase to 45.3%.

These positive therapeutic outcomes were obtained in cirrhosis of the liver, in less active forms of hepatitis, and in reactive hepatitis. Among the patients there was improved appetite, sleep normalisation, reduction of pain in the liver region, and reduced skin itching, which was accompanied by a lower activity of the liver-specific enzymes. No side-effects were observed for the intravenous laser irradiation of the blood.

In a further study (Kovaljova et al., see Annex) the lipid normalising effect of intravenous laser therapy in combination with laser acupuncture in patients with diabetes mellitus was examined. A total of 89 patients were involved with 29 patients as a control group. The lipid profile was examined for all patients, blood glucose, enzymatic blood activity and clinical manifestations of the angiopathy were monitored and biomicroscopy of the conjunctivas was performed. These tests were performed before the treatment, during the second week immediately after the treatment, and nine months after the end of the treatment. The treatment with laser irradiation was carried out in blocks during a nine-month period. One block consisted of 8 to 10 sessions in months 1, 3 and 9 with intravenous laser irradiation of blood using a wavelength of 630 nanometer with an intensity of 2 mW and a duration of 15 to 30 minutes. The outcomes revealed that the 29 patients in the control group showed no relevant deviations of their blood plasma lipids after a 10-day therapy with AEVIT. The same parameters were monitored in the control examinations. As the attached work shows, a positive influence on the blood glucose level was achieved, together with positive changes in the parameters of lipid metabolism. A significant increase in HDL was evident, and a lowering of the LDL. In addition, there was a lowering in the levels of both triglycerides and cholesterol. The changes in laboratory findings are of the same order of magnitude as induced by the administration of statins.

Extremely interesting outcomes were also observed in studies of the treatment of multiple sclerosis. The therapeutic outcomes are similar to those resulting from the use of interferon in this indication. The results of this study are currently being tested. Experience up to now confirms the claims made, but larger studies are still required. A whole series of studies is directed at the intravasal laser therapy of chronic, non-specific lung diseases with bronchodysplasia. The results show a statistically clearly significant improvement of the clinical and functional problems. In almost 80% of the subjects there were no longer any detectable endoscopic signs of an inflammatory process after the treatment.

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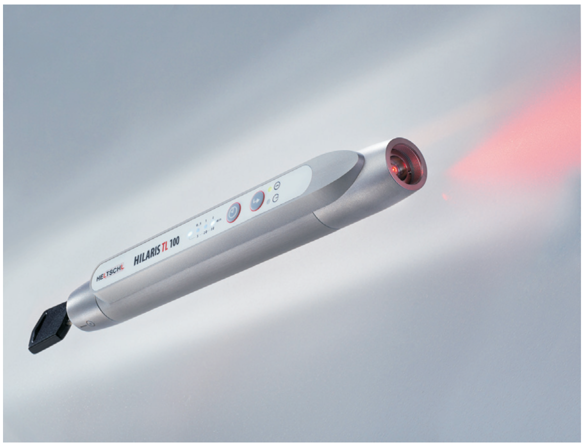

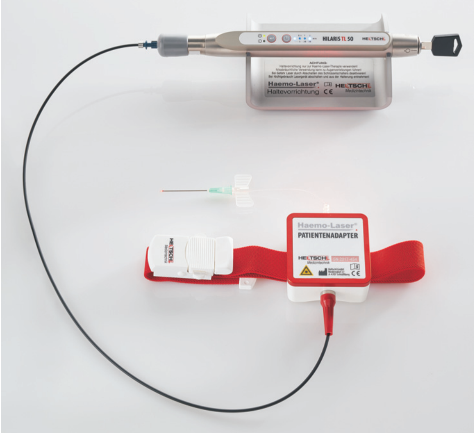

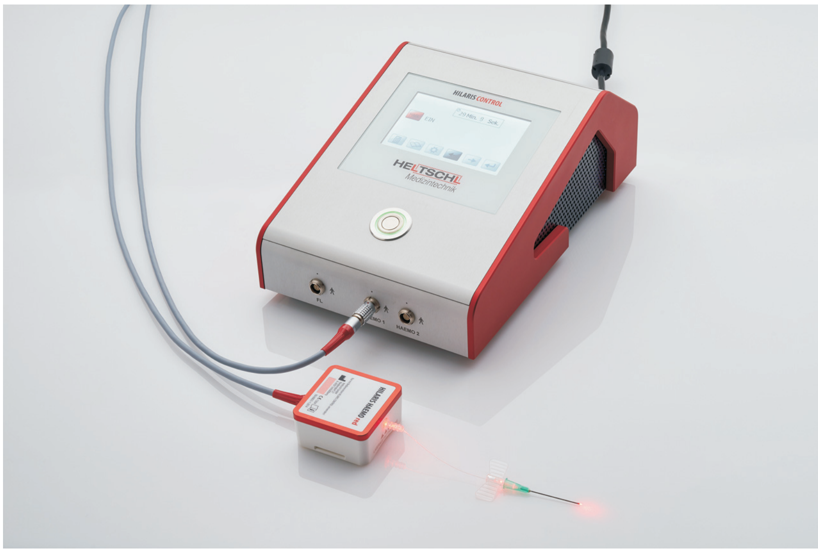

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