

In Vivo Effects

Vopr Kurortol Fizioter Lech Fiz Kult. 2003 Jul-Aug;(4):36-9.

[Effect of low level infrared laser irradiation on hemostasis (experimental study)]

[Article in Russian]

Efimova EG, Cheida AA, Kaplan MA.

Roentgenostructural, spectral analyses, functional testing of the hemostatic system in experimental animals demonstrated that infrared low-intensity laser radiation changes functional activity of proteins of the hemostatic system. The effect of the radiation depends on the dose and frequency of the radiation impulses. One of the complications is DIC-syndrome which may develop if the exposure dose on the radiation point in tissues with blocked circulation reaches 9.5 mJ/cm² and higher.

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[Resonance response of cell-tissue structures to impulse frequency of infrared laser radiation of low intensity (experimental study)]

[Article in Russian]

Cheida AA, Efimova EG, Kaplan MA.

A morphological evaluation of the results of transcutaneous radiation of male mice with infra-red impulse laser beam for 10 min (10,100, 1000, 10,000 Hz) 5 min, 3 and 24 hours after the procedure has confirmed the existence of "resonance" frequencies for different types of endocrine cells and has shown that the response depends not only on the dose of infrared low-intensity laser radiation. Thus, account for resonance frequencies is one of perspective approaches to optimization of laser therapy which may raise effectiveness and safety of laser exposure.

Effect of low-power GaAlAs laser (660 nm) on bone structure and cell activity: an experimental animal study.

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Low-level laser therapy (LLLT) is increasingly being used in the regeneration of soft tissue. In the regeneration of hard tissue, it has already been shown that the biomodulation effect of lasers repairs bones more quickly. We studied the activity in bone cells after LLLT close to the site of the bone injury. The femurs of 48 rats were perforated (24 in the irradiated group and 24 in the control group) and the irradiated group was treated with a GaAlAs laser of 660 nm, 10 J/cm² of radiant exposure on the 2nd, 4th, 6th and 8th days after surgery (DAS). We carried out histomorphometry analysis of the bone. We found that activity was higher in the irradiated group than in the control group: (a) bone volume at 5 DAS ($p=0.035$); (b) osteoblast surface at 15 DAS ($p=0.0002$); (c) mineral apposition rate at 15 and 25 DAS ($p=0.0008$ and 0.006); (d) osteoclast surface at 5 DAS and 25 DAS ($p=0.049$ and $p=0.0028$); and (e) eroded surface ($p=0.0032$). We concluded that LLLT increases the activity in bone cells (resorption and formation) around the site of the repair without changing the bone structure.

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Low-power laser irradiation improves histomorphometrical parameters and bone matrix organization during tibia wound healing in rats.

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The influence of daily energy doses of 0.03, 0.3 and 0.9 J of He-Ne laser irradiation on the repair of surgically produced tibia damage was investigated in Wistar rats. Laser treatment was initiated 24 h after the trauma and continued daily for 7 or 14 days in two groups of nine rats ($n=3$ per laser dose and period). Two control groups ($n=9$ each) with injured tibiae were used. The course of healing was monitored using morphometrical analysis of the trabecular area. The organization of collagen fibers in the bone matrix and the histology of the tissue were evaluated using Picrosirius-polarization method and Masson's trichrome. After 7 days, there was a significant increase in the area of neoformed trabeculae in tibiae irradiated with 0.3 and 0.9 J compared to the controls. At a daily dose of 0.9 J (15 min of irradiation per day) the 7-day group showed a significant increase in trabecular bone growth compared to the 14-day group. However, the laser irradiation at the daily dose of 0.3 J produced no significant decrease in the trabecular area of the 14-day group compared to the 7-day group, but there was significant increase in the trabecular area of the 15-day controls compared to the 8-day controls. Irradiation increased the number of hypertrophic osteoclasts compared to non-irradiated injured tibiae (controls) on days 8 and 15. The Picrosirius-polarization method revealed bands of parallel collagen fibers (parallel-fibered bone) at the repair site of 14-day-irradiated tibiae, regardless of the dose. This organization improved when compared to 7-day-

irradiated tibiae and control tibiae. These results show that low-level laser therapy stimulated the growth of the trabecular area and the concomitant invasion of osteoclasts during the first week, and hastened the organization of matrix collagen (parallel alignment of the fibers) in a second phase not seen in control, non-irradiated tibiae at the same period. The active osteoclasts that invaded the regenerating site were probably responsible for the decrease in trabecular area by the fourteenth day of irradiation.

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He-Ne laser on microcrystalline arthropathies.

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OBJECTIVE: The objective of this work is to assess the anti-inflammatory capacity of He-Ne laser therapy as determined by the plasmatic levels of inflammatory markers, fibrinogen, and TNFalpha and by histopathological study in rats with arthropathy induced by calcium pyrophosphate crystals. **Background Data:** Microcrystalline arthropathies are a group of diseases characterized by the deposit of different crystals in joints.

MATERIALS AND METHODS: Two milligrams of dicalcium pyrophosphate crystals (DCPP) were injected in both joints of the lower limbs of rats during 2 days. A group was treated with laser of He-Ne (6 mW) on the injected joints during 3 consecutive days.

After 96 h of the first injection, animals were sacrificed to determine TNFalpha using the ELISA method and fibrinogen was assessed using spectrophotometry. Sections from the lower limbs were used for histopathology. **RESULTS:** A statistically significant increase ($p < 0.001$) in plasma fibrinogen levels and TNFalpha was noted between the control group and the laser-treated group. The histological transversal section of a posterior limb joint of a rat injected with DCPP showed fibroadipose tissue with diffuse chronic infiltrate. The histopathology of the group of rats injected with DCPP and subsequently treated with He-Ne laser showed no inflammatory response. **CONCLUSION:** He-Ne laser treatment in the microcrystalline arthropathy induced in rats by DCPP injection might have an antiinflammatory effect, evaluated by fibrinogen plasma levels and TNF-alpha (inflammatory markers) and by the histopathology regressive process.

Vopr Onkol. 2003;49(1):76-80.

[Effect of low-intensity laser radiation on the functional potential of neutrophilic granulocytes in blood of tumor-bearing animals]

.[Article in Russian]

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Peripheral blood was sampled for cytochemical assay of cationic proteins from three

groups of animals--intact ones, those with tumor C45 and bearers of the same tumor treated with helium-laser radiation and chemotherapy. Radiotherapy involved such manifestations of enhanced nonspecific antitumor resistance and, in particular, mobilization of the cellular component, as increased number of neutrophils containing cationic protein granules and relatively high levels of such proteins in them. Cytochemical assay of cationic proteins in neutrophil granules may serve as a criterion of nonspecific antitumor resistance assessment.

Lasers Surg Med. 1996;19(4):433-7.

Effect of laser pulse repetition rate and pulse duration on mast cell number and degranulation.

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BACKGROUND AND OBJECTIVE: Mast cell activation by low-level laser therapy (LLLT), leading to degranulation and the release of mediators, may be one of the mechanisms by which LLLT can accelerate tissue repair in mammals. The objective of this work, part of an investigation to determine the optimum parameters for increasing mast cell number and degranulation in injured skin, was to determine the effect of different pulsing frequencies of LLLT. **STUDY DESIGN/MATERIALS AND METHODS:** Partial-thickness wounds in anaesthetized adult male Wistar rats were irradiated immediately after injury with monochromatic coherent light (wavelength 820 nm) pulsed at either 2.5, 20, 292, or 20,000 Hz at an average power density of 800 mW/cm² for 27 seconds; the energy density was 21.6 J/cm². The effects on mast cell number and degranulation were assessed 2 hours post-treatment by counting the numbers of intact and degranulated mast cells in Carnoy-fixed, toluidine blue-stained, sections of irradiated and sham-irradiated wounds. **RESULTS:** The total number of mast cells was increased significantly ($P < 0.05$) by all the frequencies when compared to the sham-irradiated group, but there was no significant difference between frequencies ($P > 0.05$). However, although the number of degranulated mast cells was higher in all laser-treated wounds, in comparison with the sham-irradiated group, only the 20 Hz (pulse duration 45 ms) and 292 Hz (pulse duration 3 ms) frequencies were significantly effective ($P < 0.05$). **CONCLUSION:** Increase in mast cell number is not pulsing frequency dependent, whereas degranulation is.

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Ultrastructure of the blood and lymphatic capillaries of the respiratory tissue during inflammation and endobronchial laser therapy.

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For wide application of low-energy laser irradiation in the pulmonary clinic, study of the structural basis of the therapeutic effect is necessary. The aim of this research is to describe the structural changes of the blood and lymphatic capillaries in the respiratory tissues during inflammation and following laser biostimulation. Comparative ultrastructural study was carried out on 127 open respiratory biopsy specimens from 45 patients with infectious-destructive lung diseases. These patients were divided into two groups, depending on tactic of pre-operative therapy: patients treated by only traditional anti-inflammatory measures and patients receiving additional laser therapy. Heightened permeability of the blood capillary endotheliocytes was noted as the initial stage in the development of the inflammatory reaction. Intensification of the process of permeability is accompanied by interstitial edema, deformation of the interalveolar septa, and structural disorganization of alveolar epithelium cells. Local lesions of microcirculation result in tissue hypoxia and induce processes of fibrosis. Laser biostimulation promotes reversion of the inflammatory process and stabilizes fibroplastic processes. Basic principles of pathogenetic therapy were stated. It was shown that low-energy laser irradiation satisfies these requirements as an additional method in the therapy of destructive lung diseases.