

[Biofizika](#). 2004 Mar-Apr;49(2):339-50.

Molecular and cellular mechanisms of the low intensity laser radiation effect

[Article in Russian]

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The main aspects of the free radical conception of the molecular and cellular mechanisms of the stimulating action of low-intensity radiation in the red region of the spectrum were considered. These are: (1) Primary acceptors of incident radiation are endogenous porphyrins, which may act as photosensitizers giving initiator-radicals for secondary free radical reactions. (2) Target cells for light irradiation during quantum therapy may be blood leukocytes, fibroblasts, keratinocytes, endotheliocytes, etc. (3) The initiation of the secondary free radical reactions due to lipid peroxidation of cell membranes (in particular, of leukocytes) brings about an increase in ion permeability including that for calcium. The increase in intracellular calcium concentration leads to phagocytes priming, i.e., to increased production of reactive oxygen species (ROS) under subsequent stimulation of the cell. (4) Photosensitized generation of ROS in the cytoplasm of some cells induces a free-radical activation of synthesis of proteins, the most significant in the light of the present concept being the de novo synthesis of inducible NO-synthase, superoxide dismutase, and various cytokines. The experimental evidence for the basic statements of the conception of free radical mechanisms for the stimulating action of low-intensity laser and noncoherent radiations is presented. A relation between the primary mechanisms of the stimulating action of light and the secondary effects that determine the sanative effect of quantum therapy in the process of wound healing (bactericidity, cell proliferation, and improved microcirculation) was established. Moreover, it was shown that nitrosyl complexes of heme proteins, such as hemoglobin and cytochrome c, are the primary chromophores of laser radiation. Upon irradiation, they can easily dissociate to produce free nitric oxide. In turn, released nitric oxide may be responsible for blood vessel relaxation and activation of mitochondrial respiration. This phenomenon is just observed during phototherapy by means of low-intensity laser radiation.