

EXPERIMENTAL IN VIVO STUDY THE PHENOMENON OF LASER INDUCED BLOOD OXYHEMOGLOBIN PHOTODISSOCIATION

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In this paper a new optical technology in local tissue oxygenation is presented. The results of the effect of laser radiation on blood oxyhemoglobin HbO_2 and its photodissociation are discussed. The results in vivo investigation the phenomenon of laser-induced photodissociation of blood oxyhemoglobin and its biomedical applications are presented. New method of control in individual response to the effect of laser radiation is proposed. It is shown that in order to make the methods of phototherapy as well as laser therapy really efficient one has to control the oxygen concentration in tissue keeping it at the necessary level.

New method of determination of therapeutic "dose" during laser irradiation that based on the use of changes in oxygen concentration as a feedback signal is developed. It is shown that photodissociation of blood HbO_2 provides a unique possibility in additional oxygen extraction and restoring normal cell metabolism.

Experimental investigation the phenomenon of laser-induced tissue oxygenation has been carried out using transcutaneous oxygen monitor (TCOM) - "Radiometer" TCM-4 (fig. 1). Direct in vivo measurements of tissue oxygen tension TcPO_2 under irradiation by He-Ne laser at the power of 1.5 mW has been taken. For this purpose usually uses Clark-type polarographic sensor ("TcPO₂ electrode") that consists of a silver anode, electrolyte, and an oxygen permeable membrane; heating section and electronic system for measuring and controlling the sensor temperature.



Fig. 1. Experimental setup for measuring local tissue oxygen concentration directly at the zone of laser irradiation

Obtained experimental results demonstrate that the process of oxygen extraction take place immediately at laser light absorption and remains constant during the irradiation (fig. 2).

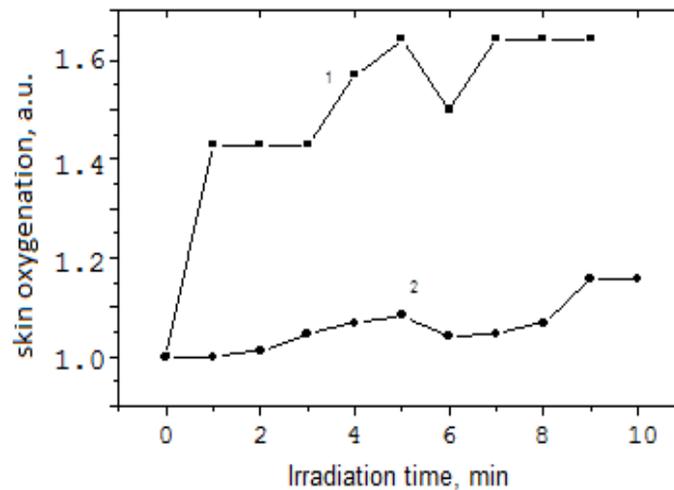


Fig. 2. Laser-induced tissue oxygenation in dependence of the time of laser irradiation: 1– in norm blood microcirculation and 2 – in the case of ischemia

As it seen from fig. 2 during laser irradiation the value of tissue oxygenation increases and exceeds its initial level by 1.6 times (curve 1). In the case of induced ischemia additional extraction of oxygen also is observed. This result clearly demonstrates that laser-induced tissue oxygenation could be applied in clinical practice for restoration of blood microcirculation as well as normal cell metabolism.

It is significant that the value of PO_2 in blood plasma reached by laser-induced photodissociation of HbO_2 is comparable to that one typically reached by the method of HBO.

Novel method allows eliminate the deficit of oxygen until a new blood vascular net is formed. This result could be applied for those pathologies where elimination of tissue hypoxia is critical.

Extra oxygen increases the rate of collagen deposition, epithelization and improve healing of split thickness grafts. Increased subcutaneous $TcPO_2$ has also improved bacterial defenses.

The efficiency of developing method is comparable to the method of HBO gaining advantages in local action.

Laser-induced enrichment the tissue oxygenation stimulates cell metabolism and allows developing new effective methods of therapy as well as laser therapy of pathologies where elimination of local tissue hypoxia is critical.

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