

Pro- and Anti-inflammatory Cytokine Content in Human Peripheral Blood after Its Transcutaneous (in Vivo) and Direct (in Vitro) Irradiation with Polychromatic Visible and Infrared Light

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Abstract

Objective: The aim of this randomized, placebo-controlled, double-blind trial was to investigate changes in the content of 10 cytokines in the human peripheral blood after transcutaneous and in vitro irradiation with polychromatic visible and infrared (IR) polarized light at therapeutic dose.

Background Data The role of cytokines in development of anti-inflammatory, immunomodulatory, and wound-healing effects of visible and IR light remains poorly studied.

Methods The sacral area of volunteers was exposed (480–3400 nm, 95% polarization, 12 J/cm²); in parallel, the blood samples of the same subjects were irradiated in vitro (2.4 J/cm²). Determination of cytokine content was performed using enzyme-linked immunosorbent assay (ELISA).

Results A dramatic decrease in the level of pro-inflammatory cytokines TNF-, IL-6, and IFN- was revealed: at 0.5 h after exposure of volunteers (with the initial parameters exceeding the norm), the cytokine contents fell, on average, 34, 12, and 1.5 times. The reduced concentrations of TNF- and IL-6 were preserved after four daily exposures, whereas levels of IFN- and IL-12 decreased five and 15 times. At 0.5 h and at later times, the amount of anti-inflammatory cytokines was found to rise: that of IL-10 rose 2.7–3.5 times (in subjects with normal initial parameters) and of TGF- β 1 1.4–1.5 times (in the cases of its decreased level). A peculiarity of the light effect was a fast rise of

IFN- γ at 3.3–4.0 times in subjects with normal initial values. The content of IL-1 β , IL-2, IFN- γ , and IL-4 did not change. Similar regularities of the light effects were recorded after in vitro irradiation of blood, as well as on mixing the irradiated and non-irradiated autologous blood at a volume ratio 1:10 (i.e., at modeling the events in a vascular bed of the exposed person when a small amount of the transcutaneously photo modified blood contacts its main circulating volume).

Conclusion: Exposure of a small area of the human body to light leads to a fast decrease in the elevated pro-inflammatory cytokine plasma content and to an increase in the anti-inflammatory factor concentration, which may be an important mechanism of the anti-inflammatory effect of phototherapy. These changes result from transcutaneous photo-modification of a small volume of blood and a fast transfer of the light-induced changes to the entire pool of circulating blood.