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Mechanisms and applications of the anti-inflammatory effects of photobiomodulation

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Abstract

Photobiomodulation (PBM) also known as low-level level laser therapy is the use of red and near-infrared light to stimulate healing, relieve pain, and reduce inflammation. The primary chromophores have been identified as cytochrome c oxidase in mitochondria, and calcium ion channels (possibly mediated by light absorption by opsins). Secondary effects of photon absorption include increases in ATP, a brief burst of reactive oxygen species, an increase in nitric oxide, and modulation of calcium levels. Tertiary effects include activation of a wide range of transcription factors leading to improved cell survival, increased proliferation and migration, and new protein synthesis. There is a pronounced biphasic dose response whereby low levels of light have stimulating effects, while high levels of light have inhibitory effects. It has been found that PBM can produce ROS in normal cells, but when used in oxidatively stressed cells or in animal models of disease, ROS levels are lowered. PBM is able to up-

regulate anti-oxidant defenses and reduce oxidative stress. It was shown that PBM can activate NF-kB in normal quiescent cells, however in activated inflammatory cells, inflammatory markers were decreased. One of the most reproducible effects of PBM is an overall reduction in inflammation, which is particularly important for disorders of the joints, traumatic injuries, lung disorders, and in the brain. PBM has been shown to reduce markers of M1 phenotype in activated macrophages. Many reports have shown reductions in reactive nitrogen species and prostaglandins in various animal models. PBM can reduce inflammation in the brain, abdominal fat, wounds, lungs, spinal cord.

Keywords: animal studies; chromophores; clinical trials; inflammation; low-level laser therapy; photobiomodulation.

Figures

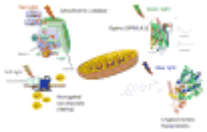

Figure 1 Chromophores in PBM. Cytochrome c...

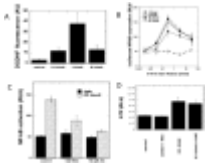

Figure 2 NFkB is activated by PBM...

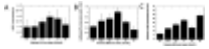

Figure 3 Dose response of 810 nm...

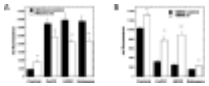

Figure 4 PBM reduces oxidative stress in...

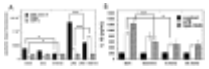

Figure 5 PBM reduces inflammatory markers in...

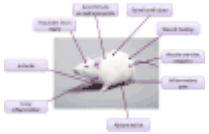

Figure 6 Animal models in which the...

All figures (7)

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