Progress in Low-Level Laser Therapy

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The presentation covers fundamental operating principles of some of the most widely used methods of Low-Level Laser Therapy (LLLT). It includes also recently developed LLLT technologies and medical devices such as LLLT cardiovascular and brain therapy, tissue regeneration and pain relive.

Use of sunlight as a therapeutic tool dates back as far as Hippocrates. In the modern era hundreds of articles have been published describing clinical and cellular responses to light. LLLT has demonstrated potent in vivo efficacy for treatment of ischemic conditions of acute myocardial infraction and stroke in multiple validated animal models. These results have been reproduced at independent academic centers. This presentation will summarize what is understood about the mechanism of LLLT involving interaction with mitochondria. The effects of LLLT are wavelength specific upon a known mitochondrial receptor (cytochrome C oxidase). Targeting of this receptor results in formation of adenosine triphosphate (ATP), enhanced mitochondrial survival and maintenance of cytochrome C oxidase activity.[8,13]

In stroke the occlusion of a major artery results in a core area of severe ischemia with blood flow reduced to less than 20% of pre-occlusion levels. The core area has a rapid loss of ATP and energy production, and the neurons are depolarized. This core of the infarct is surrounded by an ischemic penumbra which can be up to twice as large as the core of the infarct. Cells within the penumbra show less severe decreases in loss of blood flow (20 to 40% of normal). Neurons in the penumbra tend to be hyperpolarized and electrically silent. In the penumbra, the cells undergo progression of cell death lasting from hours to days after the infarct. Also, it is known that inflammation after infarct plays a role in determining the final infarct size and that anti-inflammatory modulators can reduce infarct size. It should be noted that the infarct is dynamic, with different parts of the infarct being affected to different degrees over a period of hours to days. LLLT has been implicated in a number of physiological processes that could favor cell survival in the penumbral region of a stroke and has been demonstrated to be effective at reduction of infarct volume and improvement of functional outcomes in validated animal models of stroke.

LLLT has also been used successfully in acute myocardial ischemia models in the rat and dog where similar pathways of cell death occur as in stroke. Therefore, LLLT exists as a potential therapeutic tool for serious medical conditions that cause significant morbidity and mortality to mankind.

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