Medical Xpress

Photobiomodulation of the brain: Shining light on treating Alzheimer's and other neuropathological diseases

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Photobiomodulation (PBM) offers exciting opportunities for improving the life of patients with a diverse range of brain disorders. In this special collection of articles in the *Journal of Alzheimer's Disease* experts review progress using PBM therapy to treat dementia, Alzheimer's disease,

Parkinson's disease, and other disorders and suggest larger clinical trials should be conducted as soon as possible.

Previously referred to as low-level laser (or light) therapy (LLLT), PBM is the therapeutic use of red or near-infrared light to stimulate healing, relieve pain and inflammation, and prevent tissue from dying. In recent years, PBM has been used to treat a number of brain disorders including traumatic events such as stroke, global ischemia, and traumatic brain injury; neurodegenerative diseases such as dementia, Alzheimer's disease, and Parkinson's disease; and neuropsychiatric disorders including major depression, bipolar disorder, anxiety, and post-traumatic stress disorder. Studies indicate that PBM is an effective strategy to promote microcirculation and cellular proliferation and regeneration, and to reduce pain, edema, oxidative stress, and inflammation in many traumatic, acute, and chronic diseases. There is increasing interest in using it as a brain-boosting strategy in healthy young and elderly individuals.

There is growing preclinical evidence to support the hypothesis that PBM could ameliorate neuronal oxidative stress, neuroinflammation, and apoptosis, and could also stimulate neurogenesis and synaptogenesis. Although to date the responses in animal models may be more pronounced, responses in human subjects and patients are still significant.

This collection of articles presents the current state of the art in the application of PBM therapy for dementia, Alzheimer's disease, and other brain conditions. It is guest-edited by Michael R. Hamblin, Ph.D., Laser Research Centre, Faculty of Health Science, University of Johannesburg, South Africa, and Farzad Salehpour, MSc, College for Light Medicine and Photobiomodulation, Starnberg, Bavaria, Germany, and ProNeuroLIGHT LLC, Phoenix, AZ, USA.

"Brain PBM therapy is a promising modality by which red to near-infrared light emitted by lasers or light emitting diodes (LEDs) is delivered to the scalp to stimulate neural cells and brain function," explained the Guest Editors. "It has been shown to increase cerebral blood flow and also augment cerebral metabolic capacity. Nowadays, the applications of PBM therapy are extremely diverse in modern medicine, so that it has gained considerable credibility among available therapeutic strategies."

Other articles address the following topics:

- Improving the cognitive performance of individuals with mild cognitive impairment
- Alleviating depression and anxiety during the early stage of development of Alzheimer's disease in rats
- Use of intracranial and extracranial (remote) PBM devices in Parkinson's disease
- Pilot study of dose-dependent effects of transcranial photobiomodulation on brain electrical oscillations
- Combined transcranial and intra-oral PBM therapy
- Results of PBM therapy on physical and cognitive outcomes for people with Parkinson's disease
- Optimal stimulation parameters for treating major depressive disorder

"One of the main takeaways from this collection of articles is that transcranial PBM can not only help dementia and Alzheimer's disease, but can also be used to treat Parkinson's disease, and psychiatric disorders," noted Dr. Hamblin.

According to Mr. Salehpour, "For neurodegenerative diseases, PBM will likely need to be used indefinitely on a continuing basis. It is evident that there are no significant side effects of PBM to the brain and that

different wavelengths can be used, although values around 800 nanometers appear to be most beneficial."

Looking ahead, the issue highlights the development of safe, effective LED helmets that can be used at home, and the use of various neuroimaging techniques that can provide objective evidence of a response in the brain. Advances are being made in understanding the mechanism of action of PBM at a molecular and cellular level. Boosting of brain function in healthy individuals is another growing trend.

The Guest Editors draw attention to several significant challenges to be overcome. "The questions that need to be resolved are how important is light penetration through the scalp and skull into the brain and how much effect does systemic absorption of light have," commented Dr. Hamblin. "Does specific application of light to various anatomical locations on the head have different effects on brain function? Does the biphasic dose response apply in humans, i.e., can too much light be delivered?"

"Other questions that arise are whether different individuals respond differently to PBM, and are there any biomarkers that can predict response," added Mr. Salehpour. "We also need to consider whether PBM can be usefully combined with conventional drugs or health food supplements."

Dr. Hamblin and Mr. Salehpour concluded that, "We expect PBM to continue to be investigated to treat diverse brain disorders, considering the evidence of efficacy, almost complete lack of adverse effects, and the availability of relatively inexpensive LED devices that can be used at home. We suggest that larger clinical trials should be conducted as soon as possible."

"Light therapy is one of the newest modalities to benefit patients and hold the promise of revealing the basic mechanisms underlying

Alzheimer's disease," remarked George Perry, Ph.D., Editor-in-Chief, *Journal of Alzheimer's Disease*, and Semmes Distinguished University Chair in Neurobiology at The University of Texas at San Antonio.

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