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Editorial

Neuro-Photobiomodulation: Stimulation of the Brain Using Different Frequencies

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Abstract

Neuro-photobiomodulation (PBM) is a relatively novel optical stimulation method that is not yet generally accepted in conventional medicine. Therefore, evidence-based research in this sub-area, which is important for laser medicine, is necessary in order to provide appropriate scientific evidence for a better understanding of neuro-PBM. In this editorial, a summary of the recent results with stimulation using different frequencies (e.g., 40 Hz, 136.1 Hz) is presented. The contribution is intended to stimulate researchers to continue working in this promising area of neuro-PBM.

Keywords

Neuro-Photobiomodulation; LED (light-emitting diode); light therapy; 40 Hz; OM frequency 136.1 Hz; bispectral index; basic research; integrative and complementary medicine

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1. Cerebral Photobiomodulation (PBM)

Cerebral PBM [1], a new treatment option, is still under experimental development. However, it has already been used in different approaches like traumatic brain injury (TBI) and stroke [2] or cerebral ischemia [3, 4], Alzheimer's disease [5], major depressive disorders [6], cognitive rehabilitation [7], and many other related diseases [8].

2. Frequency-modulated Optical Stimulation

The most popular method of cerebral PBM involves continuous light stimulation. Several recent studies have shown that certain frequency-modulated optical stimulations could have a very special impact on neuronal functions. Wang et al. (2019) reported that transcranial PBM with 1064-nm laser modulates brain electroencephalogram rhythms [9]. In our experiments, we used light-emitting diode (LED) stimulation instead of light amplification by stimulated emission of radiation (LASER) stimulation [10]. Interestingly, at 40 Hz frequency and 136.1 Hz (Om-frequency from meditation), significant changes in electroencephalographic (EEG) activity were noticed. In this context, a study by Hauswald et al. (2015) [11] suggested that during Zen meditation using Om-frequency, high-frequency gamma power in the cingulate cortex and somatosensory cortex positively correlated with the degree of self-reported mindfulness [12]. Our results further highlight the EEG similarities of transcranial LED induced sedation and general anesthesia as assessed by bispectral index (BIS) [8,10]. Similar results were reported by Litscher et al. (2004) during different stimulation (acupressure, laser stimulation, etc.) of the Yintang acupoint [13].

Iaccarino et al. (2016) [14] first reported the positive effects of restoring gamma (40 Hz) oscillations in the visual cortex of a transgenic mice model in Alzheimer's disease; also optogenetically driving FS-PV-interneurons at gamma (40 Hz), but not other frequencies, reduced the levels of amyloid-ß (A ß)$_{1–40}$ and A ß$_{1–42}$ isoforms.

Despite several subsequent studies, consensus on using 40 Hz stimulation for new strategies in the possible treatment of Alzheimer's disease remains elusive. Nevertheless, our experimentally performed BIS measurements showed that at least the stimulation frequency of 40 Hz could have a (possibly sedative) influence on the bioelectrical function of the brain, which in individual cases can be larger than that compared to continuous stimulation, but does not reach the level of a longer-lasting effect with 136.1 Hz frequency [10]. These preliminary findings are corroborated by the results of the neuromodulatory parameters [10], which were also collected in our experiments. The reduction in the heart rate at a frequency of 136.1 Hz also showed the soothing effects of this frequency [10]. Our results also indicated that stimulation with 136.1 Hz frequency had an influence in the 0.1 frequency band in heart rate variability (HRV) [10]. Schwerdtfeger et al. (2020) concluded that the 0.1 Hz oscillations in the heart and the brain seem to be coupled, thereby indicating central pacemakers on the heart rhythm; breathing at 6 breaths per minute could induce coherence of the 0.1 Hz oscillations; thus, facilitating physical and psychological function. They stated that central nervous system function modifies the rhythm of the heart and vice versa, suggesting that HRV could be a useful indicator of central-autonomic integration and that 0.1 Hz oscillations play a major role in physical and mental health via optimizing energy supply [15].

It is highlighted that our preliminary results only present a new PBM design, and the potential of the method should be validated with the first preliminary data in prior studies [8, 10]. Interestingly,

the maximum sedative effects were observed with stimulation of 136.1 Hz (Om frequency) [10]. For this reason, we suggest the scientific community to consider in detail our initial results obtained from our experimental dataset through this editorial in the English language. Possibly, this can initiate further research to bring more clarity to the topic.

3. Future Aspects

Neuro-PBM showed that the stimulation with different frequencies resulted in different EEG and neuromodulatory effects. Furthermore, placebo stimulation showed a different effect. This indicates that in addition to continuous stimulation, frequency-related stimulation techniques can also be extremely helpful in improving the performance of neuro-PBM.

This editorial will help in further understanding the novel methods using different frequencies to treat different conditions in years ahead, stimulating further research and motivating the practitioners and researchers to improvise PBM interventions for wider acceptance.

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Parts of this editorial have been published in modified form as a report in German language in Akupunktur & Aurikulomedizin in 2020 [10].

Author Contributions

Gerhard Litscher did all the research work of this study.

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Competing Interests

The author does not declare any conflict of interest.

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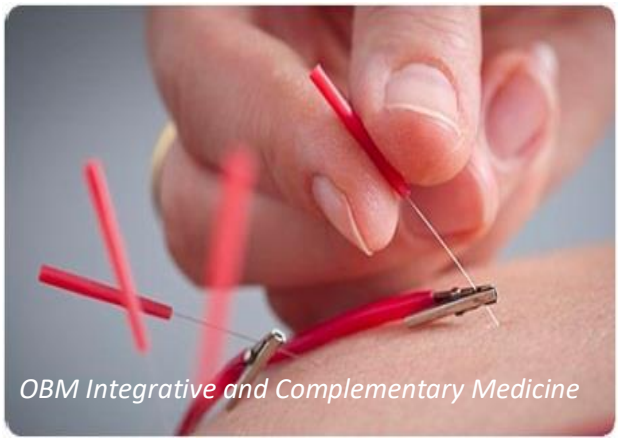

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