

Editorial

Is There Evidence of Toxicity in Long-Term Photobiomodulation?

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Abstract

This editorial briefly discusses the issue of potential toxicity in the case of long-term photobiomodulation (PBM). Scientific articles from PubMed, Google Scholar, and the China National Knowledge Infrastructure were included in a heterogeneous search. There have been very few studies on the long-term effects of PBM, as well as its potential toxicity. There is no evidence that PBM is toxic when used at therapeutic or imaging doses. There are no such concerns with intracranial PBM application (e.g., optical fiber) in either animal or human experiments.

Keywords

Photobiomodulation (PBM); laser; light; integrative and complementary medicine; toxicity; Long-term effects



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1. Introduction

Photobiomodulation (PBM) has become a widely used method in evidence-based integrative medicine because of numerous scientific publications in a wide range of medical fields. Efforts have recently increased to make this procedure more accessible to university institutions. Numerous scientific studies, textbooks, scientific societies, and practical successes support this claim. As of today (September 17, 2022), there are 2,330 scientific articles in the scientific database PubMed alone if the keyword 'photobiomodulation' is searched.

A question that has received little attention thus far is the possibility of toxicity in the case of a long-term PBM. This issue will be briefly discussed in this editorial, and previous scientific articles on it will be identified [1-9].

2. Methods

The editorial is based on a variety of sources, including scientific articles from PubMed, Google Scholar, and China National Knowledge Infrastructure (CNKI) databases. Furthermore, references are made to articles that were made available to the author in response to expert inquiries (see, for example acknowledgments). The search does not claim to be exhaustive; rather, it should be viewed as an initiative research project that should address the topic in general and demonstrate that more scientific activity should be put into this area.

3. Preliminary Results and Discussion

To predict the results immediately, there are few long-term studies on the long-term effects, as well as the toxicity of PBM. The papers emphasize that long-term effects must first be investigated. If you look at the study protocols, you will also notice that there are very few articles on the subject [1].

Nonetheless, one published article stands out because it provides preliminary results for a specific section [2]. These will be discussed briefly below.

The authors investigated the effects of long-term (up to 12 weeks) PBM application in five macaque monkeys in this study. An intracranial optical fiber device was implanted, delivering red light with a wavelength of 670 nm to the midline midbrain region. Immunohistochemistry was performed on the brains. Long-term intracranial application of PBM had no negative effects on the surrounding brain parenchyma or the nearby dopaminergic cell system, according to the findings. PBM did not cause an inflammatory glial response or neuronal degeneration near the implant site. PBM did not cause abnormal activation or mitochondrial stress in nearby cells, nor did it cause an abnormal vasculature arrangement. The authors from France and Australia discovered no histological basis for major biosafety concerns related to transcranial PBM [2]. The study did, however, have some limitations. The authors, for example, did not have a separate group of control animals that did not have transcranial PBM during the same experimental period [2].

4. Conclusions

Looking at the overall safety of long-term PBM, one can conclude that individual studies report almost no problems with PBM safety. There is no evidence that PBM is toxic when used at therapeutic or imaging doses. There are no such concerns with intracranial applications (for example,

optical fiber) in humans [3,4] or animals [5-8]. However, the studies cited used the PBM for a short or medium period of time (days to a few weeks), with only one study lasting more than a year [9]. Therefore, it is prudent to conclude that there is no cause for concern if PBM is used as a treatment modality at therapeutic doses for an extended period of time.

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Author Contributions

The author did all the research work of this study.

Competing Interests

The author hereby declares that no conflict of interests exists in connection with the publication of this editorial.

References

1. Dos Santos FF, Braga ML, Barroso MM, Oliveira VC, Oliveira MX. Effects of photobiomodulation therapy combined with exercise in patients who have chronic low back pain: Protocol for a randomized controlled trial. *Phys Ther.* 2021; 101: pzab201. doi: 10.1093/ptj/pzab201.
2. Moro C, Torres N, Arvanitakis K, Cullen K, Chabrol C, Agay D, et al. No evidence for toxicity after long-term photobiomodulation in normal non-human primates. *Exp Brain Res.* 2017; 235: 3081-3092. doi: 10.1007/s00221-017-5048-7.
3. Keller E, Ishihara H, Nadler A, Niederer P, Seifert B, Yonekawa Y, et al. Evaluation of brain toxicity following near infrared light exposure after indocyanine green dye injection. *J Neurosci Methods.* 2002; 117: 23-31.
4. Giller CA, Liu H, German DC, Kashyap D, Dewey RB. A stereotactic near-infrared probe for localization during functional neurosurgical procedures: further experience. *J Neurosurg.* 2009; 110: 263-273. doi: 10.3171/2008.8.JNS08728.
5. Darlot F, Moro C, El Massri N, Chabrol C, Johnstone DM, Reinhart F, et al. Near-infrared light is neuroprotective in a monkey model of Parkinson disease. *Ann Neurol.* 2016; 79: 59-75. doi: 10.1002/ana.24542.
6. Moro C, El Massri N, Darlot F, Torres N, Chabrol C, Agay D, et al. Effects of a higher dose of near-infrared light on clinical signs and neuroprotection in a monkey model of Parkinson's disease. *Brain Res.* 2016; 1648: 19-26. doi: 10.1016/j.brainres.2016.07.005.
7. Moro C, El Massri N, Torres N, Ratel D, De Jaeger X, Chabrol C, et al. Photobiomodulation inside the brain: A novel method of applying near-infrared light intracranially and its impact on dopaminergic cell survival in MPTP-treated mice. *J Neurosurg.* 2014; 120: 670-683. doi: 10.3171/2013.9.JNS13423.
8. Tata DB, Waynant RW. Laser therapy: A review of its mechanism of action and potential medical applications. *Laser Photonics Rev.* 2012; 1: 1-12. doi: 10.1002/lpor.200900032.

9. McCarthy TJ, De Taboada L, Hildebrandt PK, Ziemer EL, Richieri SP, Streeter J. Long-term safety of single and multiple infrared transcranial laser treatments in Sprague-Dawley rats. *Photomed Laser Surg.* 2010; 28: 663-667. doi:10.1089/pho.2009.2581



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