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Photo-biomodulation reduced Neuropathic Pain after Spinal Cord Injury by down-regulating CXCL10 expression in astrocytes and microglia through NF-κB pathway in male rats

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Statement of the Problem: Neuropathic pain (NP) after spinal cord injury (SCI) appears with spontaneous burning, tingling, electric-shock sensations, allodynia and hyperalgesia, it is a strong predictor of life quality. The treatment of NP following SCI is challenging. A significant proportion of patients with NP received no significant pain relief with pharmacological treatment or stop treatment due to unacceptable side effects. Pre-findings hints photobiomodulation (PBM) could be a non-pharmacological treatment to manage NP following SCI, however, a better understanding of mechanism contributing to PBM treatment after SCI is need. The purpose of this study is to describe the pain relief role of PBM after SCI and exploring potentially relevant cells and pathways contributing to that.

Methodology & Theoretical Orientation: A rat SCI model was established and treated with PBM for 14 days, mechanical allodynia, cold allodynia and heat hyperalgesia was measured. RNA-seq was used to find potential molecular and pathway responsible for NP relief.

Findings: PBM alleviated neuropathic pain-related behaviors, promoted motor function recovery and reduced levels of neuropathic pain-related molecules in rats after SCI. Through RNA-seq we found CXCL10 was significantly upregulated after SCI and suppressed by PBM. CXCL10 is found constitutively expressed in neurons, and for astrocytes and microglia the expression level could be increased by inflammatory induction and reduced with PBM treatment. NF-κB pathway activation was affected by PBM in the induced microglia and astrocytes which might contribute to the regulation of CXCL10.

Conclusion & Significance: PBM might inhibit the activation of glial cells in the injured spinal cord tissue, leading to a decrease in NF-κB phosphorylation levels, suppressing the expression level of the chemokine CXCL10, and to restrain the occurrence of neuropathic pain. Recommendations are made that CXCL10 might be a potential target for the prediction and detection of NP after SCI, and reflect the treatment effect of PBM.

Recent Publications

1. Wang XK, Li X et al. (2021) Photobiomodulation inhibits the activation of neurotoxic microglia and astrocytes by inhibiting Lcn2/JAK2-STAT3 crosstalk after spinal cord injury in male rats. *J Neuroinflammation* 18(1): 256.
2. Liang ZW, Lei T, Wang S et al. (2020) Photobiomodulation by diffusing optical fiber on spinal cord: A feasibility study in piglet model. *Journal of biophotonics* 13(4): p. e201960022
3. Sun JK, Zhang JW, Li K et al. (2020) Photobiomodulation Therapy Inhibit the Activation and Secretory of Astrocytes by Altering Macrophage Polarization. *Cell Mol Neurobiol* 40(1): 141-152.

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