Effects of Pulsed 810nm Al‐Ga‐As Diode Laser on Wound Healing Under Immunosuppression: A Molecular Insight

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Background and Objectives: Dysregulated inflammation is one of the major contributing factors for the prevalence of non‐healing chronic wound in immunosuppressed subjects. Photobiomodulation (PBM) has emerged as a potential non‐thermal, light‐based therapeutic healing intervention for the treatment of impaired wounds.

Study Design/Materials and Methods: The present study delineates the underlying molecular mechanisms of PBM 810 nm laser‐induced full‐thickness cutaneous wound repair in immunosuppressed rats at continuous and pulsed wave‐mode with power‐density of 40 mW/cm2, fluence 22.6 J/cm2 for 10 minutes daily for 7 post‐wounding days. Molecular markers were assessed using biochemical, enzyme‐linked immunosorbent assay quantification, enzyme kinetics and immunoblots analyses pertaining to inflammation, oxidative stress, cell survival, calcium signaling, and proliferation cascades.

Results: Results distinctly revealed that pulsed 810nm (10Hz) PBM potentially influenced the cell survival and proliferation signaling pathway by significantly upregulated phospho‐protein kinase B(phospho‐Akt), phospho‐extracellular‐signal‐regulated kinase 1 (ERK1), transient receptor potential vanilloid‐3 (TRPV3), Ca2+, calmodulin, transforming growth factor‐β1 (TGF‐β1), TGF‐βR3, and Na+/K+‐ATPase pump levels. PBM treatment resulted in reduction of exaggerated inflammatory responses evident by significantly repressed levels of interleukin‐1β (IL‐1β), IL‐6, cyclooxygenase 2 (COX‐2), and substance‐P receptor (SPR), as well as inhibited apoptotic cell death by decreasing p53, cytochrome C, and caspase 3 levels ($P<0.05$), which, in turn, effectively augment the wound repair in immunosuppressed rats. PBM treatment also lowered 4‐hydroxynoneal (HNE) adduct level and NADP/NADPH ratio and upregulated the GRP78 expression, which might culminate into reduced oxidative stress and maintained the redox homeostasis.

Conclusions: Taken together, these findings would be helpful in better understanding of the molecular aspects involved in pulsed 810 nm laser‐mediated dermal wound healing in immunosuppressed rats through regulation of cell survival and proliferation via Ca2+‐calmodulin, Akt, ERK, and redox signaling. Lasers Surg. Med.