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Mechanisms of action of photobiomodulation in diabetic wound healing

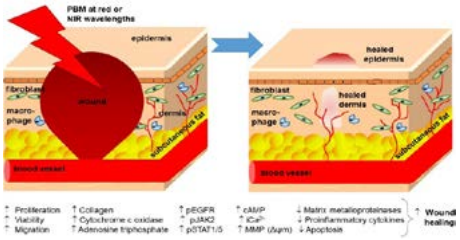
Background & Aim: Photobiomodulation (PBM), frequently referred to as low intensity laser/light therapy (LLLT), is a non-invasive, non-thermal treatment modality which induces a photochemical reaction. It involves the application of low power red and near infrared light (NIR) to injuries and lesions with the aim of reducing inflammation and edema and stimulating healing and repair. Diabetes mellitus is a chronic metabolic order which affects many of the bodies systems, and patients are prone to recurring, non-healing, chronic ulcers, particularly in the lower extremities which frequently necessitate amputation. PBM has been found to be beneficial in speeding up the healing of these ulcers and in doing so, improves the quality of life of these patients. However, the exact underlying mechanisms of action are poorly understood. The purpose of this study is to determine the underlying mechanisms of action of PBM in diabetic wounded cells.

Methodology: A diabetic wounded cell model was simulated in WS1 fibroblast cells. Cells were irradiated at 636, 660 (visible red) and 830 nm (NIR) at a fluence of 5 J/cm2. Cellular migration, viability, morphology, collagen production, extracellular matrix (ECM) proteins, enzymes involved in the mitochondrial transport chain, and various genes involved in wound healing were evaluated.

Findings: PBM in the visible red and NIR spectrum stimulated diabetic wounded cells *in vitro*. There was an increase in cellular migration, proliferation, viability, collagen production, and cytochrome c oxidase activity, as well as an upregulation of COX6B2 and COX6C. A down-regulation in proteases was also observed.

Conclusion: This work has shown that PBM is able to positively stimulate diabetic wounded cells *in vitro* and leads to healing of such wounds. Photon energy is directly absorbed by the mitochondria stimulating mitochondrial enzymatic activity and leading to the increased production of adenosine triphosphate. This leads to down-stream effects such as increased proliferation, migration and modulation of growth factors and ECM proteins all required for diabetic wound healing.

Image



Biography

Nicolette N Houreld has expertise in the areas of photobiomodulation (PBM), otherwise known as low level laser/light therapy (LLLT), and diabetic wound healing. Her research elucidates fundamental biological questions in determining the underlying molecular and cellular mechanisms of action of photobiomodulation which has leads to the promotion and development of highly competitive sustainable research of excellence. Her research has received both national and international acknowledgement for her scientific contribution in the field of Photobiomodulation. She has supervised a number of postgraduate students and sits on various university research committees. She is on the Editorial Board of an international journal, reviews papers for numerous journals, and is on the Executive Committee for an International Medical Society.

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