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Photobiomodulation at 660 nm activates signal transduction pathways in diabetic wounded cells in vitro

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A common debilitating and life-threatening complication of diabetes mellitus (DM) includes chronic diabetic foot ulcers (DFUs). At a molecular and cellular level these cells display decreased cell proliferation and migration often due to disturbances in signal transduction pathways involved in the wound healing process. Photobiomodulation (PBM) induces cellular photochemical and photophysical responses and has been shown to facilitate and hasten the wound healing process under hyperglycemic conditions. This study investigated the effect of PBM at 660 nm on cellular migration, proliferation, and survival through activation of the PI3K/AKT and Ras/MAPK signaling pathway in a diabetic wounded fibroblast cell model. Cells were irradiated at a wavelength of 660 nm with a fluence of 5 J/cm2 (power output density 11 mW/ cm2; energy 45.4 J). Unirradiated cells served as controls (0 J/cm2). Cellular migration rate, proliferation and survival was determined at 24 and 48 h post-irradiation. Proteins and receptors involved in the PI3K/AKT and Ras/MAPK signaling pathway were evaluated, as were the growth factors VEGF and bFGF as activators of the pathways respectively. Diabetic wounded cells exposed to PBM at 660 nm with 5 J/cm2 exhibited a faster migration rate, and increased proliferation and cell survival with increased VEGF and bFGF levels, as well as activation of the PI3K/AKT and Ras/MAPK pathways. These results illustrate the effectiveness of PBM at 660 nm in activating cellular pathways in deficient diabetic wounded cells to speed up the healing process of such cells, and has shown that PBM could be advantageous in the treatment of chronic DFUs.

Biography

Prof. Nicolette Houreld completed her PhD and postdoctoral studies from the University of Johannesburg. She is currently a Professor and the DST-NRF SARChI Deputy Chair-holder: Laser Applications in Health in the Laser Research Centre, Faculty of Health Sciences, University of Johannesburg. Her research interests lie in the areas of photobiomodulation and diabetic wound healing, where she investigates the molecular and cellular effects of photobiomodulation and laser tissue interaction. She is currently a C1 NRF rated scientist with a Scopus H-index of 24. She has published more than 100 papers in reputed journals and book chapters, has supervised numerous postgraduate stduents and is the president-elect for the World Association for photobiomoduLation Therapy (WALT).