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Laser-induced differentiation of adipose stem cells to functional neuronal cells

Sajan George[1], **Michael R Hamblin**[2] and **Heidi Abrahamse**[1]
[1]University of Johannesburg, South Africa
[2]Harvard Medical School, USA

Statement of the Problem: Neurological diseases and disorders pose a challenge for treatment and rehabilitation due to the limited capacity of nervous system to repair. Autologous adipose stem cells (ASCs) therapy is considerably safe and effective for clinical applications to treat nervous system disorders. Low intensity laser irradiation (LILI) acts by altering cellular signaling cascade, stimulating cellular processes and changing transcriptional modalities causing ASCs to differentiate to other cell-types. The focus of this study is the differentiation of ASCs to functional neuronal cells using LILI in the presence of cell growth factors.

Methodology & Theoretical Orientation: The effect of light on living systems and cells, referred to as photobiomodulation (PBM), is attributed to the generation of reactive oxygen species (ROS). ASCs were isolated from healthy human subjects undertaking abdominoplasty in clinics, proliferated as neurospheres and induced to differentiate into neurons in the presence of near infra-red (NIR) irradiation.

Findings: We were able to explore specific energy levels of PBM capable of generating ROS and inducing cellular biophysiological processes towards neuronal-lineages. Laser-induced differentiated neurons were isolated from the mixed population and subjected to functional analysis. Evidently, ASCs treated with growth factors and LILI possess better survivability and are capable of neuronal differentiation, which makes them an ideal choice for replacement therapies in clinics.

Conclusion & Significance: Estimating the mechanistic changes in ASCs during its transformation to other lineages allow us finding solutions to maladies with patient's own genetic background. This study gave us indications on how universal forces such as NIR (light) can manipulate the fate of a living cell in favor of growth, division, and/or differentiation. Further, it enables us in exploring methodologies for modulating signaling pathways and metabolic circuitry towards multipotency in mesodermal cells.

Recent Publications

1. Sajan George, Michael Hamblin and Heidi Abrahamse (2018) Current and future trends in adipose stem cell differentiation in neuroglia. Photomedicine and Laser Surgery 36(5):230-240.
2. Sajan George, Anine Crous, Heidi Abrahamse (2018) Reprogramming of adipose-derived stem cells to neuronal-lineage cells is regulated by cell signaling and redox status. Frontiers in Stem Cell and Regenerative Medicine Research (FSCRMR) by Bentham Science Publishers.
3. Shang-Ru Tsai and Michael Hamblin (2017) Biological effects and medical applications of infrared radiation. J. Photochem. Photobiol. 170:197-207.
4. Moore T J and Heidi Abrahamse (2014) Neuronal differentiation of adipose derived stem cells: progress so far. Int. J. of Photoenergy DOI: 10.1155/2014/827540.

Biography

Sajan George is an enthusiastic researcher in infectious diseases, cancer and stem cell biology. He has functioned as a Veterinarian and Clinical Researcher in industry as well. He has been involved in phase II clinical trials of anti-fungal drugs in canines and pharmacokinetic testing of liposomal anti-cancer drugs in non-human primates. His research towards the comparison of *Mycobacterium* spp. harboring dairy cows' and *in vitro* infected macrophages has unveiled the adaptations of pathogen for survival and virulence. His Master's thesis has identified the effect of feed antibiotics on weanling piglets using functional genomics and proteomics approaches. His Doctoral research activity is differentiation of adipose stem cells (ASCs) to functional neurons using low-level laser irradiation.

georgesajan@hotmail.com