Noninvasive Stem Cell Labeling Using USPIO Technique and their Detection with MRI

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Background: To date, several imaging techniques to track stem cells are used such as positron emission tomography (PET), single photon emission computed tomography (SPECT), Bioluminescence imaging (BLI), fluorescence imaging, CT scan and magnetic resonance imaging (MRI). Although, overall sensitivity of MRI compared to SPECT and Bioluminescence techniques are lower, but due to high spatial resolution (~100 mm), long term three-dimensional imaging capability, in vivo quick access to images in three different sections, and noninvasiveness it is being used as the method of choice.
Methods: The present study is the search results for authors and sources of information in the field of molecular and cellular imaging to examine the problems and perspectives about stem cells labeling with Ultrasmall Super Paramagnetic Iron Oxide (USPIO) and their tracking by MRI.
Results: With the advancement of technology, including quantum physics, chemistry, and computer software, MRI with an excellent spatial resolution and contrast, is surpasses other imaging modalities in the analysis of anatomical and pathological features and images of all body tissues. From the other side, advances in the astronomical science, chemistry and nanotechnology, high biocompatibility and cytotoxicity of nanoparticles, and due to analysis in the metabolic pathways of iron made the procedure easier; however, there are still several fundamental questions in understanding the mechanism of biological molecules in the living cells including: 1- How to detect not only the location but also the performance of the labeled cells? Probably combination of USPIO nanoparticles with other reporter genes as contrast agents for MRI and PET can simultaneously be used to overcome these limitations 2) How to trace stem cells from pre-clinical models to translate to humans? Up to now, due to issues of bioethics, little studies have been done in this area. 3) Whether the transplanted stem cells that have reached the target tissue, will remain or migrate? Despite the fact that cell proliferation and exocytosis are two main factors for long term protection of USPIO nanoparticles inside cells, their signals cannot be received for a long time. 4) What mechanisms cause stem cells reaching the target tissue to react with their environment? And 5) what is the number of transplanted cells in live tissue, and what is their half-life?
Conclusion: This study showed that USPIO nanoparticles can enter the cell with a clear dose without any adverse biological effects and could be detected by SWI and T2* techniques under MRI (1.5 Tesla) scanner for almost one month. MRI as a secure mean can illustrate with optimal resolution the spatial-resolution and three-dimensional positions of the stem cells.
Keywords: Ultrasmall Super Paramagnetic Iron Oxide (USPIO), labeled stem cell, in vivo tracking, MRI.

Poster Presentation

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