Molecular MRI and PET methods for detection of transplanted stem cells and cancer

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Stem cell therapies hold great potential for treatment of neurodegenerative disease. In this setting, the inability to monitor grafted cell dynamics in the central nervous system results in limited understanding of cell fates underlying therapeutic response, making therapy design and optimization significantly more challenging. To address this limitation, we aim to design, evaluate, and develop new imaging approaches for a method for imaging human stem cells *in vivo*. Over-expression of the manganese transporter protein DMT1 in human neural progenitor cells (hNPC) causes increased intracellular accumulation of the T_1-shortening agent Mn^{2+} and the novel positron emitter $^{52}Mn^{2+}$. This work addresses three specific hypotheses: (1) hNPC over-expressing DMT1 are suitable for *in vivo* cellular imaging, (2) *in vivo* ^{52}Mn PET and manganese-enhanced MRI are applicable for cell tracking in the rat brain, and (3) Mn-based imaging can be used to detect grafted stem cell location and survival *in vivo*. In addition, we apply the techniques and knowledge developed for stem cell tracking to the characterization and initial *in vivo* testing of a novel cancer-targeted MRI contrast agent, Gd-DO3A-404.