MR and iron magnetic nanoparticles. Imaging opportunities in preclinical and translational research

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ABSTRACT

Ultrasmall superparamagnetic iron oxide nanoparticles and magnetic resonance imaging provide a non-invasive method to detect and label tumor cells. These nanoparticles exhibit unique properties of superparamagnetism and can be utilized as excellent probes for magnetic resonance imaging. Most work has been performed using a magnetic resonance scanner with high field strength up to 7 T. Ultrasmall superparamagnetic iron oxide nanoparticles may represent a suitable tool for labeling molecular probes that target specific tumor-associated markers for *in vitro* and *in vivo* detection by magnetic resonance imaging.

In our study, we demonstrated that magnetic resonance imaging at 1.5 T allows the detection of ultrasmall superparamagnetic iron oxide nanoparticle conjugated antibody specifically bound to human tumor cells *in vitro* and *in vivo*, and that the magnetic resonance signal intensity correlates with the concentration of ultrasmall superparamagnetic iron oxide nanoparticle antibody used and with the antigen density at the cell surface. The experiments were performed using two different means of targeting: direct and indirect magnetic tumor targeting. The imaging of tumor antigens using immunospecific contrast agents is a rapidly evolving field, which can potentially aid in early disease detection, monitoring of treatment efficacy, and drug development. Cell labeling by iron oxide nanoparticles has emerged as a potentially powerful tool to monitor trafficking of a large number of cells in the cell therapy field. We also studied the labeling of natural killer cells with iron nanoparticles to a level that would allow the detection of their signal intensity with a clinical magnetic resonance scanner at 1.5 T.

Magnetic resonance imaging and iron magnetic nanoparticles are able to increase the accuracy and the specificity of imaging and represent new imaging opportunities in preclinical and translational research.

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