In Vivo Magnetic Resonance Detection of Cancer by Using Multifunctional Magnetic Nanocrystals

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In vivo magnetic resonance detection of cancer by using multifunctional magnetic nanocrystals

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Abstract: The unique properties of magnetic nanocrystals provide them with high potential as key probes and vectors in the next generation of biomedical applications. Although superparamagnetic iron oxide nanocrystals have been extensively studied as excellent magnetic resonance imaging (MRI) probes for various cell trafficking, gene expression, and cancer diagnosis, further development of in vivo MRI applications has been very limited. Here, we describe in vivo diagnosis of cancer, utilizing a well-defined magnetic nanocrystal probe system with multiple capabilities, such as small size, strong magnetism, high biocompatibility, and the possession of active functionality for desired receptors. Our magnetic nanocrystals are conjugated to a cancer-targeting antibody, Herceptin, and subsequent utilization of these conjugates as MRI probes has been successfully demonstrated for the monitoring of in vivo selective targeting events of human cancer cells implanted in live mice. Further conjugation of these nanocrystal probes with fluorescent dye-labeled antibodies enables both in vitro and ex vivo optical detection of cancer as well as in vivo MRI, which are potentially applicable for an advanced multimodal detection system. Our study finds that high performance in vivo MR diagnosis of cancer is achievable by utilizing improved and multifunctional material properties of iron oxide nanocrystal probes.

Index Keywords: Biocompatibility; Cell culture; Cells; Diagnosis; Diseases; Iron oxides; Magnetic resonance; Magnetic resonance imaging; Nanostructured materials; Advanced multimodal detection system; Cell trafficking; Magnetic nanocrystals; Optical detection; Tumors; fluorescent dye; nanoparticle; superparamagnetic iron oxide; trastuzumab; article; biocompatibility; cancer diagnosis; cancer transplantation; cell transport; conjugate; conjugation; controlled study; crystal; diagnostic test; diagnostic value; gene expression; human; human cell; in vivo study; magnetism; nuclear magnetic resonance imaging; Animals; Antibodies, Monoclonal; Cell Transplantation; Crystallization; Ferric Compounds; Fluorescent Antibody Technique; Humans; Magnetic Resonance Imaging; Mice; Microscopy, Electron; Molecular Probes; Nanostructures; Neoplasms; Spectrometry, Fluorescence; Time Factors; Tumor Cells, Cultured

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