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Nanoparticles in Magnetic Resonance Imaging

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Abstract

Magnetic resonance imaging (MRI) provides crucial roles in diagnosis and treatment of human diseases. More and more new MRI techniques have been developed recently. Among them, chemical exchange saturation transfer (CEST) imaging (Figure 1) has shown its promising for noninvasive pH imaging and metabolic imaging [1]. Nanoparticles have also been studied widely in the field of magnetic resonance imaging, including disease detection and stem cell migration. For example, superparamagnetic iron oxide nanoparticles (SPIONs) have been intensively studied for their biomedical applications as T2 contrast agents in MRI. We collaborated with Zhang BL group [2] and found that compared with other nanoparticles, SPIONs exhibit highmagnetic responsivity which can reduce the amount of the contrast agents needed for calcium-responsive MRI, low cytotoxicity, higher biocompatibility and chemical stability. The assessment of changes in the extracellular calcium concentration by magnetic resonance imaging would be a valuable biomedical research tool to monitor brain neuronal activity. The nanoparticles, EGTA-SPIONs, have potential as smart contrast agents for Ca^{2+}-sensitive MRI. We also collaborated with Bu WB group [3] and found that both T1-weighted imaging and in vivo pH mapping can be successfully acquired on the kidney and glioblastoma (GBM) of the mouse after intravenous injection of the T1/CEST $NaGdF_4$@PLL nanodots (NDs), demonstrating the feasibility of such an anatomical and functional dual-mode imaging technique on one magnetic resonance machine by the rational design of MRI contrast agents. Meanwhile, the PLL shell exhibits a sensitive CEST effect that depends on the pH value of the lesions. Attractively, these ultrasmall nanoagents could be excreted through urine with negligible toxicity to body tissues, which has been demonstrated by the blood biochemistry, hematology, and tissue H&E staining analysis.

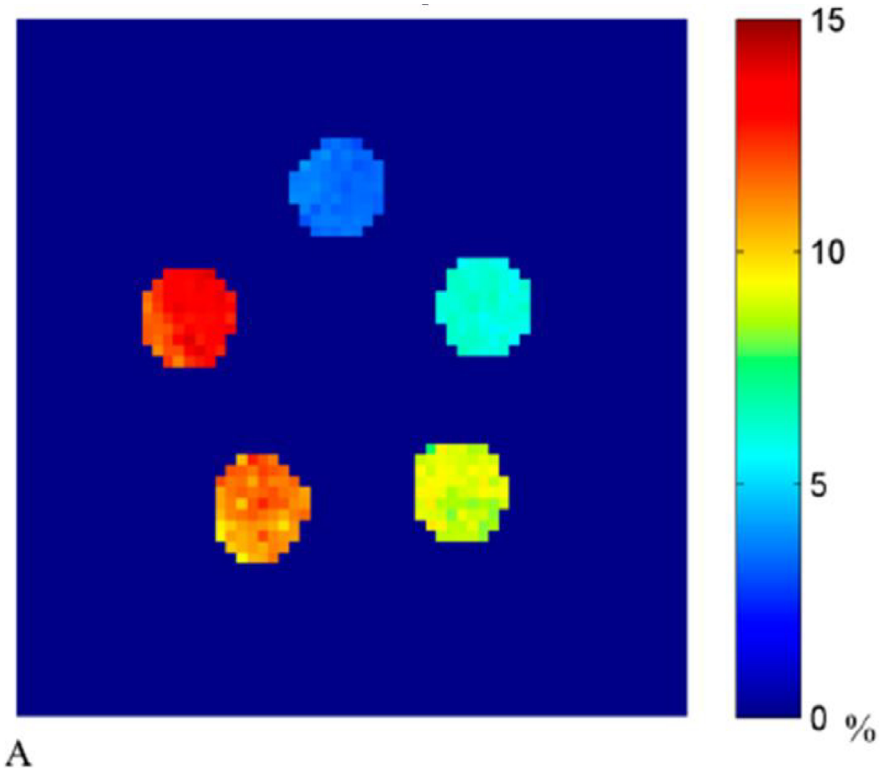

Figure 1. CEST images of creatine tubes of different concentrations.

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