iDQC anisotropy map imaging for tumor tissue characterization in vivo

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Introduction

Intermolecular multiple quantum coherence (iMQC) imaging is a new advanced technique that provides information not available from conventional MR imaging[1-3]: this technique can enhance regions of anisotropy in structured samples[4-8] and visualize local dipole fields created by super paramagnetic iron oxide nanoparticles (SPION)[9]. Though iMQC images generally have a very poor signal to noise ratio (SNR), our *in vivo* results demonstrate that we can get very clean images that highlight only regions of high anisotropy, most likely related to the regions of maximum loading of the nanoparticles.

Method

In this study nude mice were inoculated with human breast cancer cells. After the tumor vascularization the mice received an injection of a new kind of contrast agent, LHRH-SPION (luteinising hormone-releasing hormone-conjugated superparamagnetic nanoparticles)[10,11]. In the LHRH-SPION contrast agent the cellular uptake of the SPIONs is improved by coating the magnetic core with luteinizing hormone releasing hormone (LHRH), which has receptor sites in breast cancer cells.

Standard spin echo and a series of three intermolecular double quantum images (iDQC) were acquired *in vivo* and *post mortem*. The combination of three different iDQC images (with the correlation gradient pointing in three orthogonal directions) gave us the anisotropy map.

Results

Figure 1 shows in vivo standard spin echo and the iDQC anisotropy map images. The iDQC anisotropy image (|z|-|x|-|y|, where x, y, and z represent the direction of the correlation gradient) shows an interesting new feature: tumor region highlighting. Theoretical results show that regions of high intensity signal correspond to regions of high anisotropy. Experiments suggest that anisotropy is more visible in tumors than surrounding tissue masses.

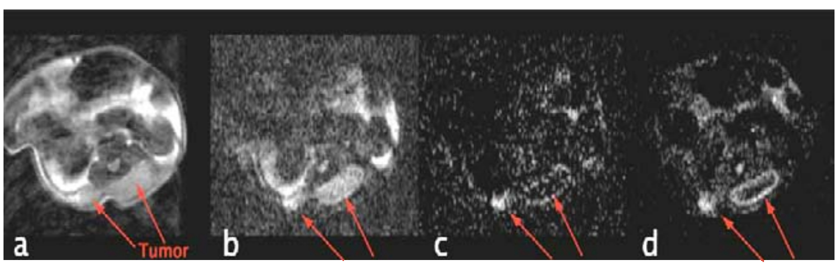

Figure 1:
a) in vivo axial spin echo image of the mice breast tumor;
b) in vivo iDQC image;
c) in vivo iDQC anisotropy map image;
d) post mortem iDQC anisotropy map image

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