Evaluating SPIO-labelled cell MR efficiency by three-dimensional quantitative T2* MRI

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Evaluating SPIO-labelled cell MR efficiency by three-dimensional quantitative T2* MRI

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An in vitro MR-assay for superparamagnetic iron oxide (SPIO) particle cell labelling assessment via three-dimensional quantitative T \textsuperscript{1} MR microscopy was proposed. On high-resolution images, and due to the high susceptibility difference between the particles and the surrounding medium, SPIO internalized in cells induces signal loss which may be counted and measured on T \textsuperscript{1} maps. The increase in both labelled cell percentage and the average perturbation volume with an added amount of iron in the incubation medium proved that intracellular iron uptake is dependent upon the initial concentration of incubation iron. It also proved that the observed increases in total cellular iron uptake measured by inductively coupled plasma optical emission spectroscopy are due to both an increase in the iron mass per cell and also an increase in labelled cell concentration. MR results were compared with Prussian blue staining histology. The sensitivity of the MR methodology was then used to distinguish labelling differences for two different types of particle coating. The MRI-assay we proposed is a compulsory tool to optimize labelling efficiency in order to improve in vivo cell detection. Key parameters for detection, such as the percentage of cell labelling, the effect on the image for a given amount of internalized iron and labelling distribution among a cell population, are easily obtained. The comparison of different contrast agents for labelling one cell type, the assessment of one type of contrast agent for labelling different cell types and/or the evaluation of labelling strategies, are possible without having recourse to classical methods, and provide improved accuracy, since the principle is based on intracellular relaxivity.

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