Whole body Dynamic Contrast Enhancement study using Wideband MRI: Non-small cell lung cancer animal model

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Abstract

A whole body Dynamic Contrast Enhancement (DCE) study has been done using Wideband MRI for a Non-small cell lung cancer animal model. With a W=4 wideband acceleration, the whole body imaging time of 128 high-resolution images can be reduced to 10mins per single scan. High-resolution images show the difference after gadodiamide (Gd) contrast agent injection in several organs.

Introduction

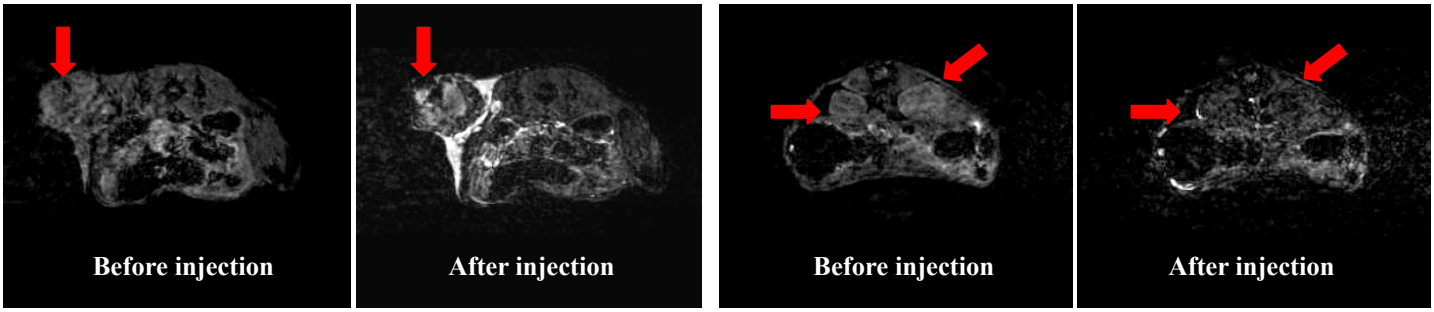
In-vivo behaviors of contrast agents and targeted medicines in tissues are important guidelines of medicine research. With designed composition and structure, contrast agents and targeted medicines bind with the protein receptors on the diseased tissues. Dynamic Contrast Enhanced (DCE) MRI uses MR imaging to track the entrance of diffusible contrast agents into tissue over time. It reflects the flow and distribution of the injected contrast agent. From the known properties of the imaging sequences it is possible to convert the relative signal increase into a quantitative measure of contrast agent over time in tissue. Limited by the total scan time in practice, DCE studies can only concentrate on several slices of a specific region of interest. It is difficult to screen cancer metastasis or perform whole body diagnosis under such constraints. Wideband MRI is an acceleration technique which is able to acquire multiple slices from different positions without additional scan time [1,2,3], its combination with DCE makes the scanning of multiple organs possible, or even whole body scanning in a short period of time. With the use of Wideband MRI scan time can be easily reduced to 25% of the original time in this case of W=4.

Material & methods

Non-small cell lung cancer (NSCLC) cell line, CL1-0, were chose to induce xenograft tumor in the severe combined immunodeficiency (SCID) mice as murine model. Four weeks after tumor implantation, the mice could be used for MR imaging. In this study we choose to use W=4 Wideband acceleration, with a total coverage of 10cm that encompasses the mice from head to tail with TR/TE=39.3ms/15ms. Field of view for each slice is 4cm x 2.5cm, while having a matrix size of 256 x 128. The spatial resolution is 156μm x195μm x195μm, which is fairly fine along all 3 dimensions. The mice were anesthetized by isoflurane, and injected gadodiamide (20 μl, 0.05 m mole/ml, OMNISCAN) via the jugular vein with a 30G needle connected to a syringe with 100 cm polyethylene tubing. According to the positive image enhancement property of Gd, the signal of organs containing Gd particles is supposed to increase signal intensity with accumulation over time.

Results

After contrast agent injection, the whole-body 3D Wideband MR image has shown gadodiamide enhanced signal intensity over several body parts from head to feet, especially in the region of tumor. Not only has the tumor itself but also tissue surrounding it been lit up by the contrast agent. (Fig. 1 (a)) On the other hand, because of contrast over-accumulation, signal intensity decreased in the region of kidneys. (Fig. 1 (b)) this special property of Gd contrast agent has been observed in other molecular imaging experiments.



(a) (b)

Fig.1 sets of images before (left) and after (right) Gd contrast agent injection. The corresponding positions are: (a) tumor (b) kidneys

Discussion & conclusion

We have successfully combined Wideband MRI with Dynamic Contrast Enhanced study to achieve a fast whole body scan with Gd contrast agent., A set of whole body scan mice image only took 10mins per scan using a wideband acceleration factor of W=4. Wideband MRI has proven to be useful scanning the whole body within a short period of time. We believe an even faster scan time can be achieved with the corporation of parallel imaging as we stated in our previous studies [4], which is what we will be working on in the future.

References

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