MP-RAGE techniques for imaging the mouse abdomen at 9.4T

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Introduction

The use of transgenic or mutant murine models with single gene mutations allows the function of particular genes to be studied. Phenotyping, i.e. the measurement of observable characteristics of a model, provides information regarding gene function. MRI, which allows non-invasive assessment of gene function within the context of the whole body, is an ideal phenotyping tool, especially when a visible phenotype is not apparent unless the model is exposed to stimuli. At high fields (9.4T), the intrinsic tissue characteristics, such as T1, are significantly longer than at standard clinical field strengths, conferring less marked tissue contrast and longer scan times. Systemic doses of gadolinium have been used to shorten T1[1] and so, shorten scan times - but often contrast agents are used for targeted tissue labelling and so their use may be inappropriate. We are therefore developing the use of a standard MRI sequence, MP-RAGE [2], to obtain 3D volume sets to provide superior image quality for the evaluation of mouse models. We present here initial work in tailoring MP-RAGE for examining the internal organs of mouse models for evaluating transgenics at 9.4T.

Methods

Scans were performed on a 9.4T Varian Inova (Palo Alto, CA) with 20G/cm gradients. C56BL/6 mice were scanned post mortem. The RF coil was a 35mm ID bird cage coil (Magnetic Resonance Laboratories, Oxford, UK). The scan parameters for the MP-RAGE sequence were: 15/5/1700 msec (TR/TE/TI), 20° flip angle, single average and 0.5 msec between inversion pulses, FOV 30x27x41mm, matrix 256x192x192, scan time 17 minutes.

Results and Conclusions

MP-RAGE images of the abdomen provide good delineation of a number of organs including the spleen, kidney and liver (Figs. 1 and 2) with resolution of 0.117mm x 0.014mm x 0.213mm. The interwoven network of blood vessels and connective tissue in the spleen is clearly evident as well as the distinction between the kidney cortex and medulla (Fig. 2). The liver is clearly discerned from the surrounding tissues including the stomach with areas of low signal intensity from blood vessels (Fig. 1). Furthermore, individual vertebrae of the spine are clearly distinguishable (Fig. 1). The 3D MP-RAGE datasets allowed easy interpretation of anatomy and the sequence can be extended to provide FLAIR, STIR and T1 weighted 3D volume sets in live mouse models. We anticipate these tools will be extremely useful in the evaluation of transgenic mice with or without the concomitant use of contrast agents.

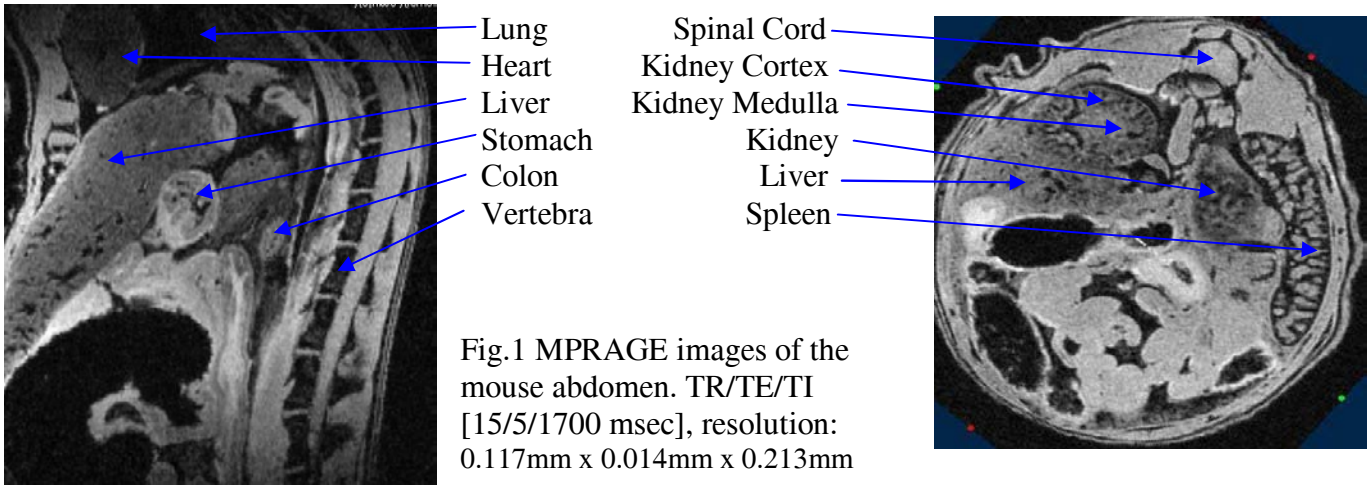

Fig.1 MPRAGE images of the mouse abdomen. TR/TE/TI [15/5/1700 msec], resolution: 0.117mm x 0.014mm x 0.213mm

References: 1) GA Johnson, GP Cofer, SL Gewalt, LW Hedlund, *Morphologic Phenotyping with MR Microscopy: The Visible Mouse*. Radiology, 2002 **222**: 789-793. 2) J Muggler, J Brookeman, *Three-Dimensional Magnetization-Prepared Rapid Gradient Echo imaging (3D MP-RAGE).* MRM 1990 **15**:152-157.

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