In-vivo Diagonal-SPRITE imaging at 9.4T

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Introduction

Although MRI is the preferred imaging modality for soft tissue, it does not always provide good images of solid or semi-solid tissues, including bones, tendons and fibrotic tissues. Recently methods for imaging at ultra short TE's (UTE) have been investigated and show it is possible to detect *in-vivo* some of these "*MR invisible*" components (1,2). We are investigating the use of single point imaging (SPI) techniques for *in-vivo* UTE imaging at high magnetic fields and have developed a novel version of SPRITE (3) in order to image preclinical disease models. The method, called Diagonal-SPRITE, achieves diagnostic quality images in an acceptable scanning time. Preliminary *in-vivo* UTE MR images of murine models are presented.

Pulse Sequence Development

Gradient strength and duty cycle limitations are important considerations in the implementation of UTE. In order to overcome potential duty cycle limitations of our gradient set (20 G/cm, 9% duty cycle) a diagonal k-space trajectory (Diagonal-SPRITE) (Figure 1) was applied instead of the half echo PR method which suffer B0 field inhomogeneity, susceptibility, and chemical shift artefacts (4). By using this improved SPRITE technique we were able to achieve UTE MR images at 9.4T with an echo time (tp) of 350 µs and resolution of .178 mm x .178mm x 1.4mm

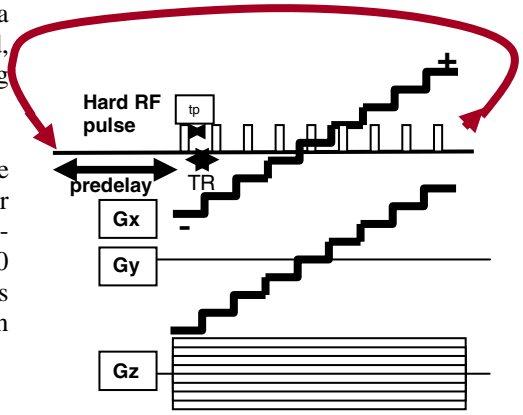

Fig 1: Diagonal-Sprite pulse sequence. Stepped but oscillating X and Y gradients define a diagonal trajectory in k-space. A conventional gradient on the third imaging axis makes the sequence a three dimensional method.

Methods

All scanning was carried out using a 9.4T horizontal bore Varian scanner (Palo Alto, CA) using a 25mm ID birdcage rf coil (Magnetic Laboratories, Oxford UK) in accordance with the UK Animals (Scientific Procedures) Act 1986. Three experiments were performed in order to image: the brain the heart and pulmonary vessels and the liver and stomach of healthy mice. The mice were positioned in the rf coil, anaesthesia was maintained at 1.5% isoflurane in oxygen and body temperature was maintained using warm air. The Diagonal-SPRITE scan parameters: TR 1 ms, tp 0.35msec, matrix 168x168x21, FOV 30x30x30mm, 1 avg, scan time 48 min. After scanning, the mice were allowed to recover.

Results and Discussion

Fig2 A,B,C show typical images obtained with Diagonal-SPRITE. of the brain, lungs and liver. The in-plane resolution of 0.178 mm allows to see details of different organs. In particular Figure 2B shows details of lung vasculature without the use of contrast agents or respiratory gating techniques, Similarly, the UTE method allows detection of solid components within the stomach (Fig 2C), normally invisible to standard MRI imaging. Although SPRITE techniques are intrinsically slow, the trade-off of having single point data which has minimal susceptibility and chemical shift artefacts, provides many advantages at 9.4T. Furthermore, a single point imaging technique provides potentially excellent point spread function characteristics.

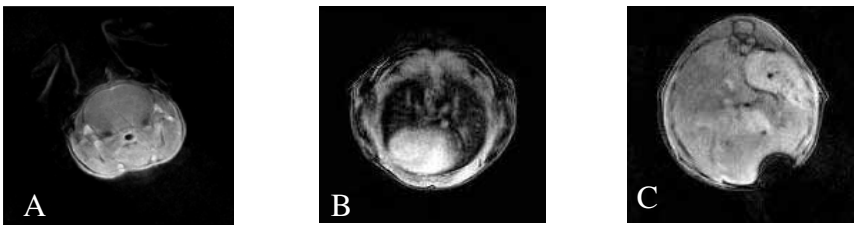

Figure 2: Diagonal-SPRITE transverse plane image of A) brain, B) heart and pulmonary vessels, C) stomach and liver of an *in-vivo* murine model (tp=350usec, in palne resolution=0.178mm)

References

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