

The effect of dielectric pad on MR images of the upper abdomen at 3T

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Introduction

Despite its excellent signal to noise ratio, MR images of the abdomen at 3T are degraded by B1-inhomogeneity caused by dielectric effect. Schmitt et al showed that the use of dielectric pads filled with water or ultrasound gel are both effective ways to reduce the signal loss from eddy currents and dielectric resonance in abdominal MRI at 3T on HASTE, T2 weighted, and T1-Flash (1). Others recommend the use of solution bag filled with saline for abdominal and pelvic MRI at 3T on spin echo T1-weighted image or fast spin echo T2-weighted images (2). We initially used solution bag, then dielectric pads (RF cushion: Siemens) of ultrasound gel has become available. The pad seems useful for improving homogeneity, but its use may be uncomfortable due to its weight. As far as we know, there is no publication comparing the effect of solution bag and ultrasound gel pad. In addition, most studies regarding signal inhomogeneity focused on fast spin-echo T2-weighted image and not much on other sequences. Therefore, this study aimed to evaluate the effect of dielectric pads (both ultrasound gel and solution bag) on abdominal MRI at 3T, with several sequences clinically used at 1.5T MRI.

Materials and Methods

Ten healthy volunteers (male 8 female 2: age 22-50) were scanned by 3 T MR scanner (Magnetom Trio, Siemens, Erlangen, Germany) with 8-channel body array coil. Haste (TR/TE/flip angle: 3000 ms/103 ms), T1-FLASH (TR/TE: 247ms/ 2.2 ms) and Fat saturated T1-FLASH (TR/TE: 247ms/ 2.2 ms), diffusion weighted image (DWI) (TR/TE: 2000 ms /73 ms) with respiratory triggering, b= 0, 1000. Images were obtained. All the sequences were obtained with breath holding, except that DWI obtained with the use of respiratory triggering. A set of sequence was repeated with RF cushion (US gel doped with Gd-DTPA), solution bag (doped with MnCl₂), and nothing. Different side of the RF cushion was used for fat saturated and non-fat saturated images according to the instruction.

Image evaluation

On axial image, one representative slice containing or close to umbilical portion of the portal vein was selected for ROIs analysis. Signal intensity of the right (anterior middle and posterior) and left lobe was measured by placing ROIs (Fig 1). For comparison, mean signal intensity of the four points was calculated. Based on these data, the ratio of minimum signal intensity versus maximum signal intensity among the four ROIs were calculated and used as a marker of heterogeneity. For DWI, images at b = 0 was used for analysis. For statistical analysis, paired-t-test with Bonferroni correction was used for statistical analysis.

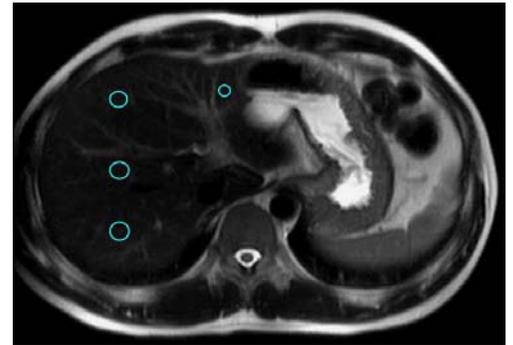


Figure.1 Four ROIs on liver

Results

SI of the liver at HASTE or DWI (b=0) was significantly inhomogeneous without using any dielectric pad (right) than when using RF cushion (left) or water solution bag (middle). Signal homogeneity was stable in T1-FLASH. No significant difference of signal homogeneity was found between images with RF cushion (left side) and water solution bag (middle), although images with RF cushion tended to be more homogeneous (Figure 2)

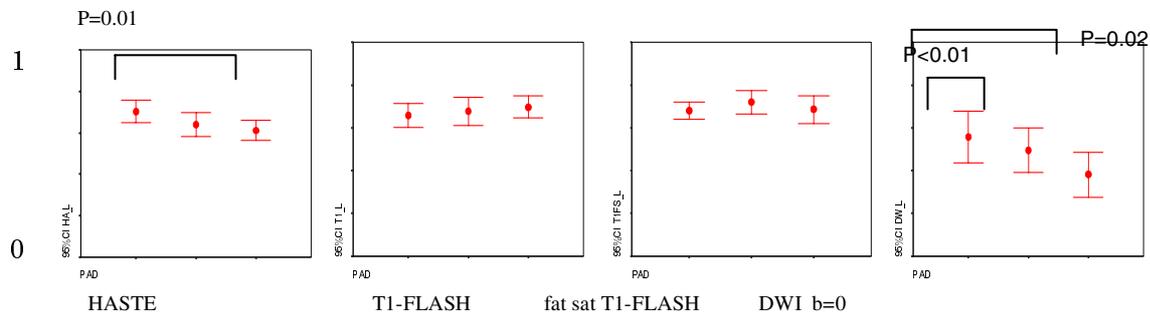


Figure 2. Graphs showing the ratio of minimum / maximum signal intensity among four points in liver (mean + 95% CI) with ultrasound gel pad (left), water solution bag (middle), and without dielectric pad (right).

Discussion

The current preliminary study demonstrated that dielectric pad has improved signal inhomogeneity in some MR sequence for upper abdomen imaging including liver. Significant improvement in homogeneity was observed on HASTE and DWI. On the other hand, T1-FLASH was relatively stable to the B1 inhomogeneity. Although B1 homogeneity varied among individuals, the result of this study suggests that the use of dielectric pad is recommended when MR images on HASTE or DWI of the upper abdomen is obtained at 3T, until other technique of improving B1 inhomogeneity (3) has become available.

References

1. M. Schmitt et al., ISMRM 12th Meeting (2004); 197
2. M. Sreenivas et al., ISMRM 13th Meeting (2005); 2745
3. M. Schmitt et al., ISMRM 13th Meeting (2005); 331