

Subjective symptoms during MRI of the upper abdomen and pelvis at 3T

M. Kataoka^{1,2}, H. Isoda², Y. Maetani², Y. Nakamoto², T. Koyama², S. Umeoka³, K. Tamai², A. Kido², T. Saga⁴, N. Morisawa², Y. Miki², and K. Togashi²

¹Radiology, University of Cambridge, Cambridge, United Kingdom, ²Diagnostic Imaging and Nuclear Medicine, Kyoto University, Kyoto, Japan, ³Radiology, Japan Red Cross Society Wakayama Medical Center, Wakayama, Japan, ⁴Molecular Imaging Center, National Institute of Radiological Sciences, Chiba, Japan

Introduction

MR imaging at 3T is becoming popular for its theoretical doubling effect of SNR, which in turn can be used to increase spatial resolution or temporal resolution. Using 3T MRI, however, has several problems: specific absorption rate (SAR) at 3T is four times larger than that at 1.5T when all the other parameters are equivalent (1-3). This quadratic increase in SAR limits the application of 3T MRI in clinical setting. Currently scanning at 3T for human subjects follows the guidance defined by IEC. Scanner automatically estimates the SAR of the sequence and operator modifies the protocol so that the SAR does not exceed the limits. Despite this, we frequently encounter that the subjects complain of mild heating sensation at 3T MRI. It is observed more frequently at upper abdominal scanning, the reaction differs among people. The report focusing on the symptom of the subject is limited. Therefore, we aimed to investigate the frequency and degree of subjective symptoms of the human subjects and its relation to specific MR sequence and other factors.

Materials and Methods

29 healthy volunteers (upper abdomen n=14 {male 12, female 2} age range 33-59 y.o., and pelvis n=15 {all female} age range 22-38 y.o.) were scanned by 3 T MR Scanner (Magnetom Trio, Siemens, Erlangen, Germany) with 8-channel body array coil. Each volunteer was fully explained about the possible symptoms at 3T scanning including heating sensation, general discomfort, peripheral sensory stimulation, tinnitus and dizziness, nausea and vomiting, burning. Ratio of estimated SAR versus SAR limit shown by scanner was recorded for each sequence. Following the scan, volunteer was asked to evaluate the symptoms during the scan in 5-point scale. 1: none to 5: severe: unbearable and cannot continue the scanning. Symptoms were rated for each sequence. The scanning protocols were based on those used routinely in 1.5T MRI but modified to make the best use of high SNR at 3T. Details are as follows.

Upper Abdomen: MRCP (TR 9000 msec / TE 916 msec / slab thickness 50mm/ flip angle 150 degree) Coronal HASTE (TR 1500 msec / TE 106 msec / flip angle 150 degree / slice thickness 1.4 mm or 2.8 mm), 3D-T2WI with PACE (1700msec / 817msec (variable due to triggering and SAR limits) / 150 degree / 1.2 mm with PACE navigator-echo triggered acquisition).

Pelvis: Axial and Sagittal T2WI (3200-3600 msec / 94-103 msec / 150 degree / 2.0 mm), Sagittal HASTE (3000 msec / 100 msec / 156 degree / 5.0 mm), Axial diffusion-weighted image (2200 msec / 80 msec / 3.0 mm / b=500,1000 s/mm²), Axial T1WI (700 msec / 11 msec / 120 degree / 3.0 mm). Slice number was reduced in some case so that expected SAR was within the IEC limit. Solution bag filled with water was used to reduce B1 inhomogeneity.

Results

For upper abdominal MR scanning, most of the volunteer noticed mild heating sensation through the scanning. Frequency of other subjective symptoms was very lower and 12 volunteer rated this as 1 (none). Comparing the score of heating sensation among sequence, coronal HASTE with 1.4 mm slice thickness (the sequence with highest ratio of estimated SAR versus SAR limit among all the sequences) scored the highest regarding heating sensation. For pelvic MR scanning, only 5 out of 15 noticed mild heading sensation. Regarding other subjective symptoms, all the volunteer who rated them as 1 (none). The maximum score of heating sensation throughout the scan (highest score among all the sequences) for upper abdomen (orange) and pelvis (blue) were summarized in figure 1. The entire volunteer felt the protocol was acceptable and no one asked to stop scanning during the study due to unbearable heating or discomfort.

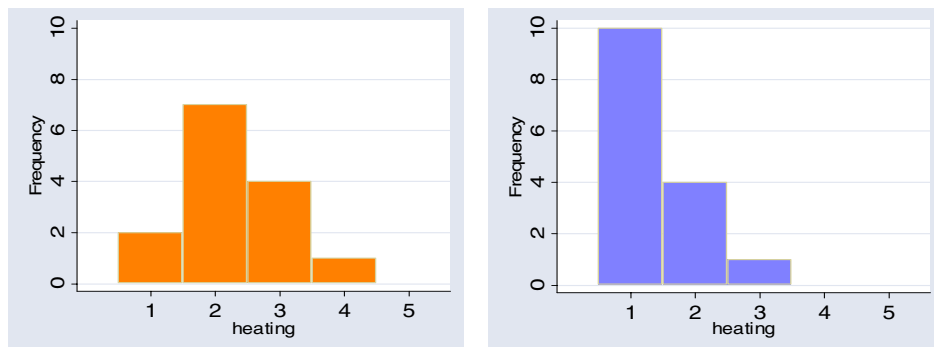


Figure 1 (a) Upper abdomen (n=14)

Figure 1 (b) Pelvis (n=15)

Figure 1

Histogram showing the distribution of the maximum score of heating sensation throughout the scan (highest score among all the sequences) of upper abdomen (a: left: orange) and pelvis (b: right: blue). The symptom during the scan was scored by subjects in 5-point scale. 1: none to 5: severe: unbearable and cannot continue the scanning.

Discussions and Conclusions

The current study demonstrated that subjective symptoms during 3T MR imaging of the upper abdomen were acceptable in the current healthy population. Heating sensation was the commonest among all the possible subjective symptoms in abdominal MR scanning, especially in upper abdominal scan. Our study population is limited to healthy adult and thus may not be directly applied to patients who might be in poor control of body temperatures. This result suggests that 1) the heating sensation should be carefully monitored when 3T MRI of the upper abdomen or pelvis are performed in the clinical setting. 2) there is a need for decreasing heating sensation felt by those who undergo abdominal 3T MRI by improving scanner and sequences.

References

1. Shellock FG. JMRI (2000) 12: 30-36
2. Kangarlu A. Concepts in Magnetic Resonance 12: 321-359
3. Schick F. European radiology (2005) 946-959