INVERSION RECOVERY PREPARED PSIF FOR FLAIR AT 7T

Yiu-Cho Chung[1], Yanjie Zhu[1], Xin Liu[1], and Chao Zou[1]

[1]*Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Key Laboratory for MRI, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, Guangdong, China*

Introduction

Despite the promise of higher SNR and improved contrast at 7T, SAR limitation and B1 transmit field inhomogeneity are limiting the clinical utilization of 7T systems. These issues are more important in spin echo based sequences and specifically for FLAIR as the use of inversion pulse together with the series of refocusing pulses in T2 weighted TSE increases RF energy deposition to the patient [1]. As such, we propose to use inversion recovery PSIF (or IR-PSIF) for FLAIR imaging of the brain at 7T. PSIF uses short TR and excitation pulses (instead of high energy refocusing pulses), greatly reducing RF energy deposition and scan time. We hypothesize that images with FLAIR contrast can be obtained by combining inversion recovery (IR) pulse with single shot 2DPSIF. Our first results showed that the technique gives one T2w image with submillimeter spatial resolution in less than 5 seconds and may be a good alternative for conventional FLAIR imaging of the brain at 7T.

Materials and Method

Sequence In IR-PSIF, the use of PSIF to replace segmented TSE in FLAIR would drastically reduce RF energy deposition. PSIF is a SSFP technique where only the spin echo part is collected. Its T2 weighting comes from the long T2 decay extending over one or more TR cycles [2]. PSIF has lower SNR than other SSFP techniques but the 7T offers SNR advantage to this sequence. Fig.1(a) shows the sequence implementation used [4]. Cerebrospinal fluid (CSF) is suppressed by applying an IR pulse before PSIF, separated with 2DPSIF by a properly selected inversion time (TI). See Fig.1(b).

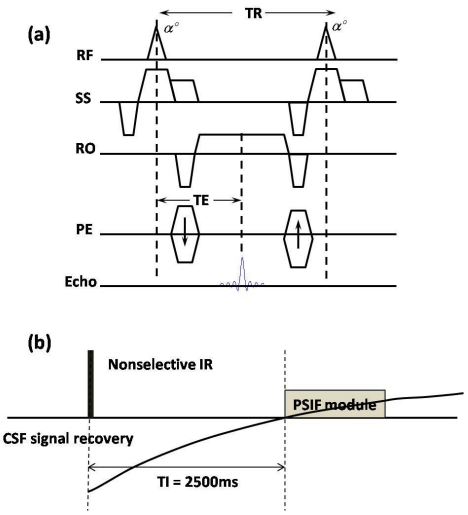

Fig. 1: Timing of IR-PSIF. (a) the 2D PSIF sequence, and (b) use of IR before 2DPSIF to suppress CSF.

Volunteer study The test was performed on a 7T system (MAGNETOM 7T, Siemens, Erlangen, Germany). A head coil with 1 quadrature transmit channel and 24 parallel receive channels (Nova Medical Inc., MA, USA) was used. The sequence was tested on 3 healthy volunteers (all with informed consent). Interleaved multislice 2D FLAIR and single slice 2D IR-PSIF was performed. Nonselective IR pulse was used for IR-PSIF. TI was set to 2500ms in both sequences. Comparison was performed on a single slice based on SNR for white matter (WM). The pixel size was 0.68mm x 0.68mm, the slice was 4mm thick. See Table 1 for imaging parameters used.

Table 1. Imaging parameters used in IR-PSIF and FLAIR

	TR (ms)	TE(ms)	Scan time	Bandwidth (Hx/pixel)	Flip angle	Resolution
IR-PSIF	4.1-4.8	2.1-2.5	4.5s per slice	579-930	58°70°	320x320
TSE	9000	96	6.7min for 9 slices	289	130°	

Results

The scans were successful in all 3 volunteers. Fig.2 showed the two images from one of the volunteers. The image contrast of the two images were similar except for two differences. The center of the IR-PSIF image was slightly darker than the sourrounding tissues, and in the IR-PSIF image, the appearance of some vessels were slightly different from those of the FLAIR images. The average SNR of WM for IR-PSIF and FLAIR were 44 and 73.5. IR-PSIF has lower SNR than FLAIR, but still high enough for diagnostic application.

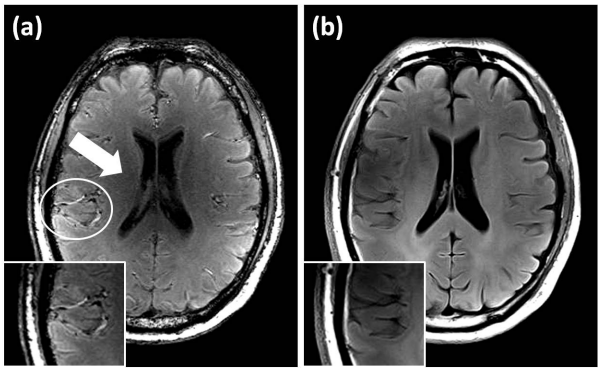

Fig. 2: Brain images from (a) IR-PSIF and (b) FLAIR. Note the darker signal at the image center in (a) (white arrow) and the different flow related signal property in the two images (circle).

Discussion and conclusion

The dark signal at the center of the IR-PSIF image may be caused by B1 transmit field inhomogeneity [4] as a relatively high flip angle was used in the experiment. Use of a lower flip angle for PSIF may avoid this issue without significantly impacting SNR. The signal differences of the vessels may be caused by the different flow properties of PSIF and FLAIR. Despite the relatively lower SNR of IR-PSIF compared to FLAIR, images from IR-PSIF were sharp and clear. The use of single shot acquisition in PSIF reduces scan time and is robust to motion. This preliminary study showed that IR-PSIF is feasible and may be used instead of FLAIR at 7T. More studies are needed to optimize imaging parameters for improved signal and contrast of IR-PSIF.

References

[1] Zwanenburg JJM et al., Eur Radiol, 20:915, 2010; [2] Gyngell, ML, JMR 81:474, 1989; [3] Chung YC et al., MRM 42: 335, 1999; [4] Collins CM et al., JMRI 21:192, 2005;

Acknowledgement

The generous help from the staff at Beijing Institute of Biophysics, Chinese Academy of Sciences is gratefully acknowledged. Grant support: Guangdong Innovation Team.