Implementation and Evaluation of Flow Artifact-Insensitive Fluid-Attenuated Driven Inversion-Recovery MR sequences for Imaging the Posterior Fossa.

K. Mizutani[1], A. Ishikawa[2]

[1]Department of Radiology, Kainan Hospital Aichi Prefectural Welfare Federation of Agricultural Cooperatives, Yatomi-cho Ama-gun, Aichi, Japan, [2]Medical Systems Division, SHIMADZU Corporation, Kyoto, Kyoto, Japan

Introduction

High-intensity cerebrospinal fluid (CSF) artifacts at the basal cisterns on MR images are often seen when a fast fluid-attenuated inversion recovery (FLAIR) technique is used[1]. In this study, we describe a new sequence, flow artifact-insensitive fluid-attenuated driven inversion recovery (FAIS-FLADIR), that capitalizes on the advantages of fluid-attenuated inversion recovery (FLAIR) while minimizing FLAIR-related artifacts such as those often encountered in the posterior fossa ,and while improving contrast between gray matter(GM) and white matter(WM) by using a non-selective driven inversion (DI) pulse.

Methods

The FAIS-FLADIR sequence is illustrated in Figure 1. As the inversion pulse, this sequence uses a non-selectively DI pulse which consists of 90(x), multiple 180(y) and 90(x). Using this DI pulses, the CSF signal which has very long T2 and T1 value were selectively inverted, but the WM and GM signal which has short T2 and T1 were not inverted completely. This lead improvement highly signal of WM and GM than conventional FLAIR. Although non-selective DI pulse reduce can reduce inflow artifacts, image contrast is not constant between slices. To constant contrast between slices, this sequence consisted of two scans. On first scan, slice excitation order after non-selective DI pulse is sequential order. In the second scan the excitation that each slice is excited in reverse order. Both image of same slice number were summed to constant contrast between slices on reconstruction. In this method, TI means the interval between driven inversion pulse and the excitation pulse of the center slice. In the FAIS-FLADIR, the DI pulse has newly two parameters, number of refocus pulses(NR) and preparation time(TP). Using normal volunteers, we optimized NR and TP to measure signal-to-noise ratios(SNR) and contrast-to-noise ratios(CNR) of GM and WM, and to obtain CSF inflow artifacts. Imaging was performed on a conventional 1.5T Shimadzu EPIOS MRI scanner. Imaging parameters for both sequences were 23cm field-of-view, 256x192 matrix, 20slices, 8mm thick sections with a 2mm inter-slice gap. The total acquisition time of the two scans was 4 minute 40 seconds.

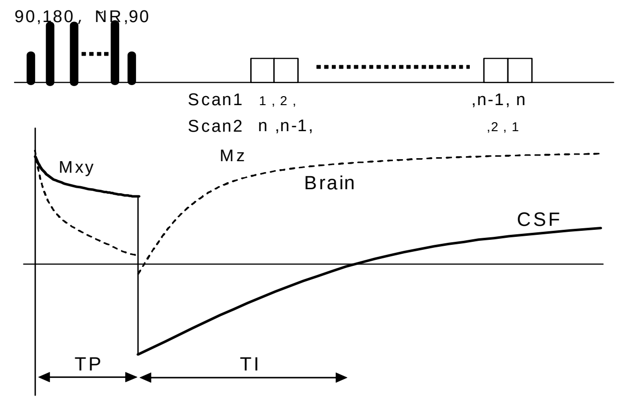

Fig.1. Evolution of magnetization over one TR

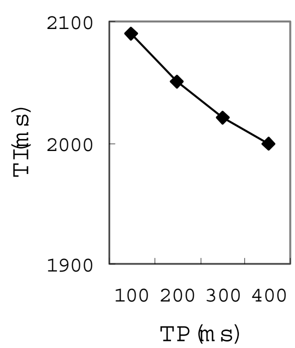

Fig.2 TP response

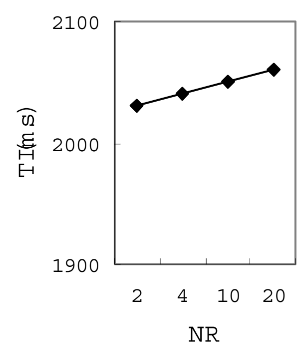

Fig.3 NR response

Results

The CSF null point(TI) was depended on both TP and NR. TI has been shortened according to the extension of TP shown as Fig.2. And TI has been extended according to the extension of NR. shown as Fig.3. Inflow artifacts were reduced by increasing NR. To saturate inflow artifacts completely, the NR need ten or more. In brain imaging shown in Fig.4, the FAIS-FLADIR provided improvement in both SNR and CNR compared with conventional FLAIR, and suppressed CSF signal and saturated inflow artifacts. In clinical, the FAIS-FLADIR was better for assessing lesions in the posterior fossa when comparing with conventional FLAIR.

Conclusion

With our sequence, based both FLAIR sequence and driven inversion technique, FAIS-FLADIR improves both SNR and CNR with suppressed CSF signal images than conventional FLAIR. This newly proposed technique was possible to replace with conventional method, since this technique does not influence at the number of the slice and scan time while maintaining flow artifact saturation performance completely.

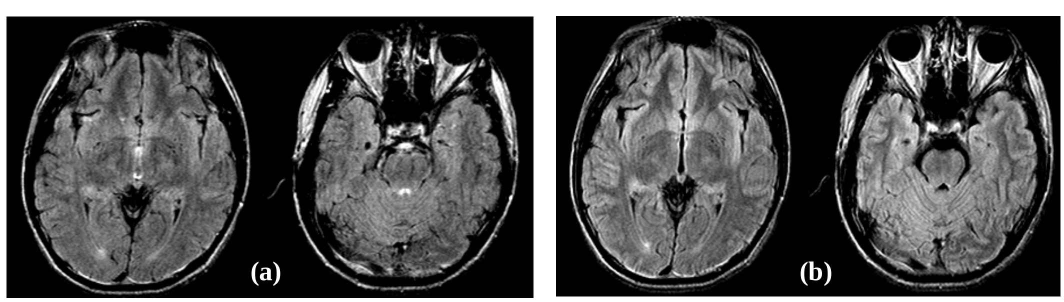

Fig.4. Human brain image using FLAIR(a) and FAIS-FLADIR(b).

References

[1] Hsiu-Mei Wu, et al: AJNR., March 1, 2002; 23(3): 393 - 399.