Propose

The propose of this study is to offer T1-weighted FLAIR and two contrast FLAIR sequence, as new application of FLAIR imaging, for intracranial disease diagnosis. The usefulness of FLAIR images in detecting intracranial lesion is well known. Conventional FLAIR sequence is generally performed to produce T2W image with null signal from CSF. However, it is known that FLAIR is able to produce various contrast at different CSF-nulling TR/TI pairs and TEs.

T1-weighted turbo IR sequence produced superior gray to white matter contrast and lesion to background contrast in the brain as compared with conventional T1W SE sequence was reported by Rydberg et al. In this study, we optimize IR value for nulling CSF signal. T1-weighted FLAIR images are obtained with optimized TR/TI pairs and short TE.

Two contrast FLAIR is obtained by turbo IR sequence in conjunction with double echo technique. From the first half echoes, T1-weighted FLAIR images are generated, and T2-weighted FLAIR images from the last half echoes. Two contrast FLAIR sequence can reduce examination time as compared with T1W and conventional T2W FLAIR sequence acquired independently.

In this study, T1-weighted FLAIR and two contrast FLAIR sequences are optimized using computer-simulated data and normal volunteers, and evaluated in clinical setting.

Methods

Signal intensity and contrast of gray matter, white matter, CSF, fat and pathologic tissues of brain were computed with an equation of IR sequence with a hybrid RARE readout. TR/TI pairs were calculated to get null point of CSF signal. These TR/TI pairs were using following studies. All MR imaging were carried out on 1.5-T MRI unit (Gyrosan ACS-NT) with OD head coil.

T1-weighted FLAIR with adequate TR/TI pairs was performed for normal volunteer to optimize TR/IR pairs in vivo. The optimized T1-weighted FLAIR was evaluated in intracranial diseases to compared with T1W SE (TR/TE; 300/10) for 32 clinical patients (25 brain tumors, 5 infarction, 2 hemorrhage).

Results

A TR/TI pair of 2000/860 was generated as adequate parameter for null pint of CSF signal for T1-weighted FLAIR imaging. In normal volunteer, good contrast between white matter and gray matter was obtained with TR of 2000 and TI ranged from 850 to 900. Image contrast of T1-weighted FLAIR was unlike conventional T1W IR, however, was similar to T1W SE with superior T1 Contrast. In the clinical setting, T1 contrast of optimized T1-weighted FLAIR (TR/TI/TE; 2000/860/10, turbo factor 6) images were superior to T1W SE. Our optimized T1-weighted FLAIR sequence was shorter examination time as compared with Rydberg's report because of increased turbo factor.

It is possible to provide both T1-weighted and T2-weighted FLAIR images using TR/TI/TEs of 3000/1250/9.6, 120 with turbo factor of 22. Longer TR/TI pairs made T2 weighting contrast, shorter TR/TI pairs made T1 weighting contrast and reducing SN ratio. TR/TI pairs of 3000/1250 gave adequate T1 contrast of first echo image and T2 contrast of second echo image. The contrast resolution and SN ratio of two contrast FLAIR were inferior to independently acquired T1W and conventional T2W FLAIR images, however, the detectability of intracranial disease was almost the same. Our optimized two contrast FLAIR sequence was 4min 30sec examination time. T1W and conventional T2W FLAIR imaging required about 7min. It was possible to reduce examination time in routine examination for intracranial diseases.

Conclusion

We conclude that the optimized T1-weighted FLAIR should replace T1W SE in diagnosing intracranial diseases, because this technique has similar signal pattern and higher contrast.

Contrast resolution of two contrast FLAIR was inferior to conventional T1W and T2W FLAIR. However, two contrast FLAIR had the same ability in the detection of intracranial lesion, and could generate T1-weighted and T2-weighted FLAIR image in same one acquisition. Two contrast FLAIR should be acceptable in clinical setting to reduce examination time, and be useful technique for the routine examination of intracranial diseases.

References

JN Rydberg et al. MRM 34:868-877, 1995
ER Melhem et al. AJNR 18:447-454, 1997