Contrast enhanced MR imaging of the brain using T1-FLAIR with BLADE compared with conventional spin echo sequence

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Introduction: Contrast enhanced MRI of the brain is acquired in various disorders such as tumor, inflammation, vascular disease and so on. For example, usually, two dimensional conventional T1-weighted spin echo (T1W-SE) images in axial, coronal and/or sagittal orientation are employed for the detection of the metastatic tumor in the brain. On T1W-SE images, flow-related artifacts are sometimes prominent especially in posterior fossa, and prevent the detection of contrast enhanced lesions. To overcome this problem, contrast enhanced MP-RAGE sequence can be used, however, some lesions do not show enough contrast enhancement compared to SE sequence. BLADE or PROPELLER (periodically rotated overlapping parallel lines with enhanced reconstruction) technique is proposed to reduce the effect of head motion in translation and rotation (1). Unlike rectilinear *k*-space sampling, this method acquires multiple echo trains of a turbo spin echo (TSE) in a rotating partially overlapping fashion, so-called blades (3). Preliminary clinical results have shown that BLADE acquisition reduces pulsation artifact from transverse and sigmoid sinus on non-contrast enhanced T1W-FLAIR and T2W-FLAIR even without motion correction (3). The purpose of this study was to compare T1W-FLAIR images with BLADE (T1W-FLAIR BLADE) and T1W-SE images for the detection of contrast enhancement in the Gd-phantom and the patients with suspected brain lesions, and to compare the degree of flow related artifacts in the patients.

Materials and methods: All scans were performed on 1.5 T MR scanner using 12 channel phased array head coil. Scan parameters for T1W-SE were TR/TE 551/14, and those for T1W-FLAIR BLADE were TR/TE/TI 1800/57/860, 19 ETL and 35 blades with identical slice thickness (6mm) and in-plane resolution as T1W-SE. Scan time was 3.1 min for both sequence. Comparison was made in axial orientation. Scan was initiated 2 min after Gd-DTPA administration, and the order of the scan was randomized in patients. Firstly, the diluted Gd-phantom lines was scanned. Gd-DTPA was diluted as the concentration of Gd-DTPA to be 2^{-n} by saline (n=0 to 24). SNR of each phantom was plotted for both sequences. Then, 24 patients with known or suspected brain metastatic lesions were included in this study. Degree of flow related artifacts were scored subjectively as 0, 1, 2, and 3 corresponding no, slight, moderate and severe. Number of lesions detected was compared for supratentorial lesions and infratentorial lesions.

Results: SNR of the Gd-DTPA diluted phantom lines were plotted (Fig. 1). The peak SNR (or enhancement) of T1W-FLAIR BLADE was larger and was shifted to lower concentration compared to that of T1W-SE. However, SNR at high concentration of Gd-DTPA by T1W-FLAIR BLADE was smaller than T1W-SE. In patients, degree of flow related artifacts was significantly lower for T1W-FLAIR BLADE than T1W-SE. Number of detected lesions by T1W-FLAIR BLADE was identical for supratentorial lesions as that by T1W-SE, and significantly larger than T1W-SE for infratentorial lesions (Fig. 2).

Conclusions: T1W-FLAIR BLADE is less susceptible for flow related artifacts especially in infratentorial region and can detect fainter enhancement compared to T1W-SE. T1W-FLAIR BLADE seems to be able to replace T1W-SE at least in axial orientation for the post contrast imaging sequence to detect brain metastasis.

References: (1) Forbes KP et al., AJNR 2003;24:794-798 (2.)Wintersperger BJ et al., Invest Radiol 2006;41:586-592

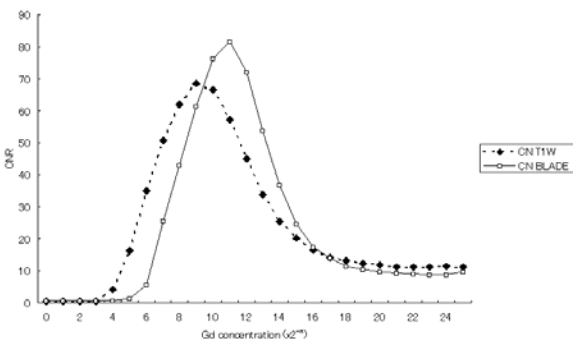

Fig. 1 CNR of Gd phantom line

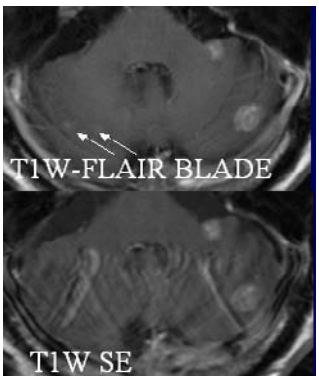

Fig. 2 Additional metastatic lesions in cerebellum were detected on contrast enhanced T1W-FLAIR BLADE (arrows) in patient with small cell lung cancer.