**Raising diagnostic accuracy in detection of brain metastasis: increasing field strength vs gadolinium concentration**

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Introduction: Contrast enhanced MRI is known to be optimal for detection of brain metastasis with high sensitivity and specificity. In recent MR studies, double- or triple-dose Gd-contrast administration was found to be effective in accurate localization of metastasis without any complications. Gadobutrol is the first commercially available 1.0M Gd contrast. With its higher Gd concentration in plasma, gadobutrol increases signal of enhanced lesions and raised diagnostic rate in brain tumors and metastasis. The purpose of this study was to compare the diagnostic efficacy of 1.5T with double dose 1.0M gadobutrol in detection of brain metastasis comparing with 3.0 T with double-dose 0.5M Gd-DTPA.

Materials & Methods: In our neuro-oncology clinic, patients suspected for brain metastasis receive double dose (0.2mmol/kg) Gd enhanced brain MRI at outpatient department. If metastasis found and indicated for gamma knife surgery (GKS), the patient takes second MRI for localization using double dose gadobutrol because of proven efficacy of 1.0M Gd contrast in detection of metastatic nodules. Among them, from December 2008 to September 2009, we retrospectively recruited patients group who received the first MRI on 3T after injection of double dose Gd-DTPA. Total 18 patients (11 males, 7 females; mean age 55 years, range 30-69) were selected and their primary sites were lung (n=12), breast (n=2), stomach (n=1), melanoma (n=1), kidney (n=1) and unknown origin (n=1). Institutional review board waived informed consent form for retrospective image analysis. We obtained anatomical T1, T2 weighted and FLAIR images. Gd-enhanced T1 weighted imaging was performed using 3D-gradient echo (GRE) sequence with 256 matrix, 1mm slice thickness and 25cm FOV on both 3T and 1.5T. TR/TE and flip angle was slightly different between two scanning; TR/TE=2300/2.98msec, FA=9° for 3T and TR/TE=25/4.5msec, FA=8° for 1.5T. The interval between two consecutive scan was ranged from 2 to 8 days. Two neuroradiologists reviewed enhanced MR images and counted the number of enhancing lesions with agreement and directly compared between Gd-DTPA enhanced 3T MRI and gadobutrol enhanced 1.5T MRI. Region of interests (ROI) were placed at enhancing portion of metastatic lesion and contralateral normal white matter, excluding the ventricular system to avoid partial volume effects. Care was taken to place the ROI in an area of homogenous contrast enhancement within the metastasis. ROIs were limited to the largest 3 lesions in cases of more than 3 metastatic lesions. Total 42 lesions were measured, and lesion-brain contrast to noise ratio was calculated. Paired t-test was used for comparison between gadopentetate dimeglumine enhanced 3.0T MRI and gadobutrol 1.5T.

Results: Gd-DTPA at 3T detected 106 lesions. Of these 18 patients, 5 patients had two lesions, 1 patient had three lesions, 4 patients had five lesions and 8 patients had more than five lesions. Gadobutrol at 1.5T found 27 additional lesions (Figure 1). They were not evident on Gd-DTPA at 3T on visual analysis. The lesion-brain CNR was higher on gadobutrol at 1.5T than Gd-DTPA at 3T (2.17±0.60 vs. 1.77±0.51, $p < 0.0001$ paired t-test, two-tailed) (Figure 2).

Conclusion: The compared to CNRs of double dose Gd-DTPA at 3.0T, one of brain metastasis showed significant increases using 1 M gadobutrol at 1.5T. Raising Gd concentration with low field MRI is much better than raising field strength with low Gd concentration.

Figure 1. 1.5T with gadobutrol found more lesions.

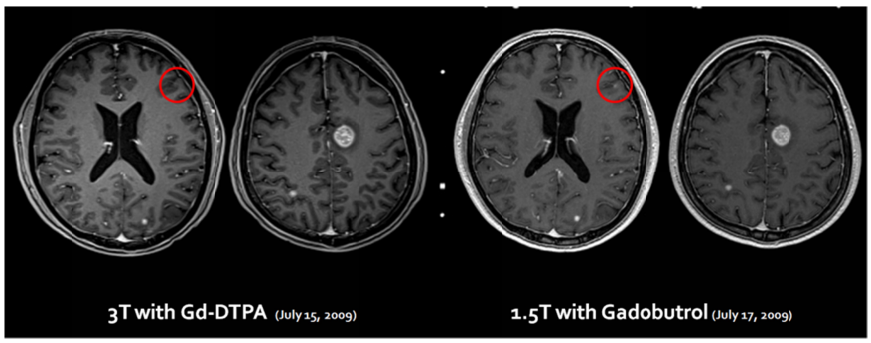


Figure 2. Higher CNR at 1.5T with gadobutrol