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The usefulness of double dose gadolinium contrast enhanced 3D FLAIR for evaluating small brain metastases and leptomeningeal metastases

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PURPOSE: Post contrast FLAIR with lower dose of Gd is helpful for superficial lesion such as leptomeningeal metastasis. However, In real clinic, higher dose of Gd injection could provide higher diagnostic yield of brain metastases. The usefulness of post FLAIR with higher dose of Gd injection is questionable. The purpose of our study is two fold. First, to prove the difference of SNR between small and larger metastases on DD Gd enhanced FLAIR. Second, to prove the usefulness of DD Gd enhanced FLAIR for evaluating small brain metastases and leptomeningeal metastases.

MATERIALS AND METHODS: 25 pairs of small($\leq$ 5 mm)and larger brain metastases (5 mm) were included for quantitative analysis. The difference of SNR between small and larger metastases on DD Gd enhanced FLAIR was compared by wilcoxon signed rank tests. 72 small brain metastases were includued for qualitative analysis. For 40 out of total 72, post 3DFLAIR was scanned after post 3DT1WI. For 32, the order of MR scan was swiched avoiding the vias of scan timing. Two reviewers graded lesions with mutual consent, using 3 point system; FLAIR is superior to T1WI: +1, equivalent: 0, inferior to T1WI: −1. The qualitative criteria are detection and conspicuitiy. The statistical differences were determined with the signed rank sum test. 15 leptomeningeal lesions were also analyzed qualitatively.

RESULTS: SNR of small brain metastases is significantly higher than SNR of larger brain metastases regardless of scan timing : 29.61 $\pm$ 8.05 vs. 17.43 $\pm$ 7.56 for early phase 3D FLAIR ($p < 0.01$), 34.38 $\pm$ 15.81 vs. 21.54 $\pm$ 13.74 for late phase FLAIR($p < 0.01$). For small parenchymal metastases, late phase 3D FLAIR is superior to early phase 3DT1W : 0.15 $\pm$ 0.73 (detection, $p = 0.26$) and 0.07 $\pm$ 0.79 (conspicuity, $p = 0.59$). Early phase 3D FLAIR is inferior to late phase 3DT1WI : −0.34 $\pm$ 0.78 (detection, $p = 0.04$) and −0.25 $\pm$ 0.88 (conspicuity, $p = 0.17$). For leptomeningeal metastases, 3D FLAIR is superior to 3DT1W regardless of scanning time.

CONCLUSION: The small brain metastases shows relatively higher signal intensity on the DD Gd enhanced FLAIR because small lesions contain relatively smaller amounts of Gd than larger lesions. Post 3D FLAIR might be still helpful for evaluating small brain metastases and leptomeningeal metastases in the setting of DD Gd contrast.