Discrepancy between arterial spin labeling images and contrast-enhanced images of brain tumors

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Target audience: Neuro-oncologists/radiologists/surgeons and MRI scientist

Purpose: In the imaging of intra-axial brain tumors, we sometimes found high signal intensity areas on arterial spin labeling (ASL) around the enhanced tumor lesions. This study investigated the clinical significance of high signal intensity on ASL images outside the contrast-enhanced

(CE) area in the imaging of intra-axial brain tumors.

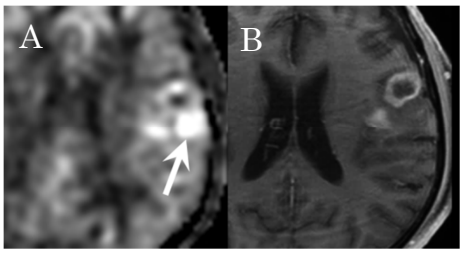

Figure 1. ASL image of a patient with glioblastoma shows hyperintensity area outside of contrast-enhancement (arrow). A: ASL, B: contrast enhanced T1WI.

Method: Images from 38 consecutive patients with intra-axial brain tumor who underwent ASL and CE-MRI with a 3T MR scanner (Discovery 750, GE Healthcare) were examined: 4 with low-grade glioma (LGG), 17 with high-grade glioma (HGG), 8 with metastasis, and 9 with primary central nervous system lymphoma (PCNSL).

ASL was performed with a pseudo-continuous technique [1] with the following parameters: 512 sampling points on eight spirals; field of view, 24 cm; reconstructed matrix, 64 × 64; TR, 4632 ms; TE, 10.5 ms; number of excitations, 2; post-labeling delay (PLD), 1525 ms; slice thickness, 4 mm; number of slices, 36; and acquisition time, 3:15 min. Post-contrast T1-weighted images were acquired using 3D-SPGR. Scan parameters were as follows: field of view, 24 cm; matrix, 384 × 256; TR, 10.4 ms; TE, 4.4 ms; slice thickness, 1.2 mm; number of slices, 140–160; and acquisition time, 3:08 to 4:05 min. Enhanced images were acquired in the sagittal plane and reconstructed in the axial plane.

Imaging findings were divided into two groups: 1) "ASL dominant", when hyperintensity on ASL was found outside the CE area; 2) "CE dominant", when ASL hyperintensity did not exist outside of enhanced area. The relationship between the imaging and histological findings was analyzed by using Mann-Whitney U test, and a p value less than 0.05 was considered significant different.

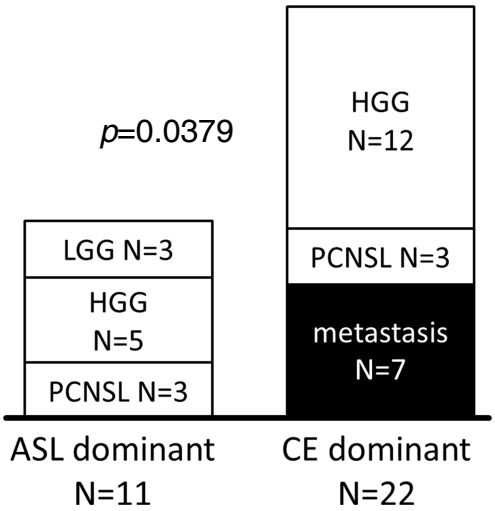

Figure 2: Bar chart showing the classification of imaging findings and histlogical diagnosis.

Result: Four cases were excluded because of poor ASL image quality and one case was excluded because absence of both enhancement and ASL hyperintensity. A total of 11 and 22 cases were classified as ASL dominant and CE dominant, respectively. The histology of ASL dominant cases was LGG in 3 cases, HGG in 5 cases, and PCNSL in 3 cases. The histology of CE dominant cases was HGG in 12 cases, metastasis in 7 cases, and PCNSL in 3 cases. All cases with brain metastasis were classified as CE dominant and the frequency of brain metastasis was significantly higher in CE dominant group (p=0.0379).

Conclusion: The high signal intensity outside the CE area is probably caused by increased perfusion or vascular proliferation, indicating the presence of glioma or PCNSL, not brain metastasis. This finding indicates a new utility for ASL images in the diagnosis of brain tumors, namely, to supplement conventional perfusion measurement obtained from ASL images.

Reference: [1] Dai W, et al. MRM. 2008;60(6):1488-97.