

## Perfusion imaging of glioma using continuous arterial spin labeling (CASL): Comparison with histopathological features.

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### Introduction

Continuous arterial spin labeling (CASL) is one of the arterial spin labeling methods which has potential to quantify cerebral blood flow (CBF). Although it is well known that the vasculature of glioma is key issue for grading the tumor, the conventional MRI method cannot image the vasculature directly. We have applied CASL to the patients with glioma, and obtained quantitative cerebral blood flow images (CASL-CBF). In the current study, we have aimed to clarify whether the map of CBF based on CASL may have the relationship to the density of microvessels in the histopathological specimen from the same patient.

### Material and methods

Eighteen cases of glioma were studied. The patients were divided into three groups based on WHO classification criteria: grade II (n=6), III (n=6) and IV (n=6). MR examination was performed on 1.5 T (Signa, GE) using multi slice single shot echo planar imaging with parameters of 64 x 64 matrix, 7 mm section thickness, slice gap of 3 mm and TR/TE = 4000/21 ms. Velocity driven adiabatic spin inversion was applied at the level of lower pons as spin labeling. 32 pairs of tagged and control images were subtracted and summed up to obtain perfusion weighted images. Perfusion signal was normalized by local signal intensity on pixel-by-pixel basis in order to compare the different examination.

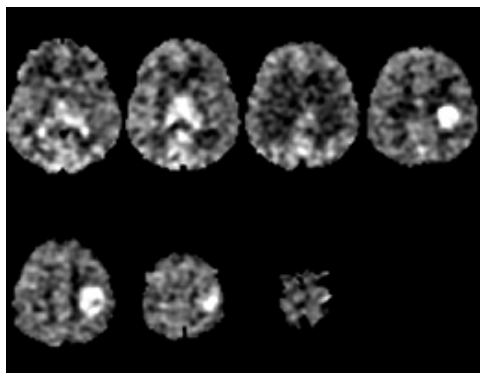
The microvessel density (MVD) was determined on the specimen immunostained with anti-CD31 in all fifteen cases by measuring the total amount of staining in each histological section. The values of perfusion signal and MVD were correlated in linear regression analyses.

### Results

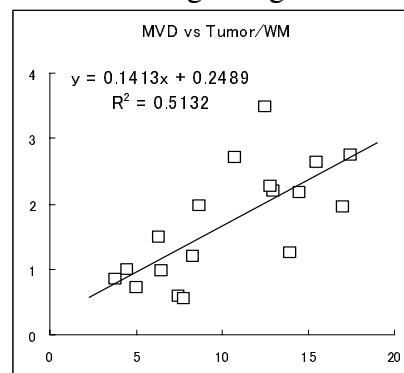
The significant correlation was found between CBF ratios in Tumor/WM calculated with CASL and MVD on histological specimens ( $r^2=0.505$ ,  $p<0.001$ ). The ratio of tumor/WM was also significantly higher in group IV compared with group II and III (t-test,  $p<0.01$ ).

### Discussion and Conclusion

Since glioma with malignant potential has more of vascular bed than low grade ones, the labeled spins reached to tumor vasculature may make the bright contrast relative to normal brain tissue. This is very consistent to the result of significant correlation between the value of CBF and MVD. In conclusion, CASL imaging can directly visualize perfusion of glioma and may provide a useful index for the tumor grading.



**Figure 1.** Perfusion weighted images of a patient with grade IV glioma. The tumor is shown as bright high signal region in left temporal lobe and left thalamus.



**Figure 2.** Scatter plots of the perfusion (tumor/WM ratio) on CASL images and MVD from the histological section.