Perifocal Apparent Diffusion Coefficient in Gliomas

M. Vittoria Spampinato[1], Ali Tabesh[2], Pritesh Topiwala[3], Muhammad U Manzoor[3], Paul Morgan[4], and Zoran Rumboldt[2]

[1]Radiology and Radiological Science, Medical University of South Carolina, Charleston, SC, United States, [2]Medical University of South Carolina, United States, [3]Medical University of South Carolina, [4]University of Nottingham

Purpose

Our aim was to assess water diffusivity within the brain parenchyma surrounding gliomas. We hypothesized that perifocal apparent diffusion coefficient (ADC) values will differ between high- and low-grade gliomas.

Methods

Twenty-one treatment-naïve patients with pathology proven gliomas (WHO grade II = 5; grade III-IV =16) were retrospectively evaluated. A tumor volume-of-interest (tumor VOI), including the lesion and any surrounding T2 prolongation, was outlined on FLAIR on the clinical pretreatment MRI. Eight incrementally dilated VOIs around the tumor VOI were obtained in 3D ranges away from the tumor VOI for a distance of 4 cm, with 5 mm incremental steps (0-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35 and 35-40 mm). A VOI was drawn within the contralateral normal-appearing white matter (NAWM) in the centrum semiovale. After exclusion of the contralateral hemisphere and cerebrospinal fluid, the mean and lowest 25th percentile (Q1) ADC values within the dilated perifocal VOIs were obtained using in-house Matlab software and normalized to the contralateral NAWM ADC. Mann-Whitney test and receiver operating characteristics (ROC) curves were used for statistical analyses. Results were considered significant when $p < 0.05$.
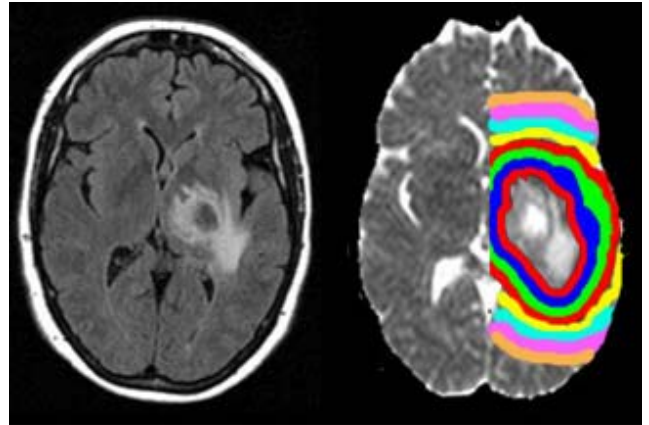
Results

Normalized mean and Q1 ADC values of the dilated perifocal VOIs were different between the high- and low-grade groups, with lower ADC values in the high-grade gliomas group. Specifically, mean ADC values were significantly different in the 3D range of 10 to 25 mm away from the tumor VOI (from the center to the periphery: mean ADC at 10-15 mm p= 0.026; at 15-20 mm p = 0.026; at 20-25 mm p = 0.013). Q1 ADC values were significantly different in the 3D range of 10 to 30 mm away from the tumor VOI (from the center to the periphery: Q1 ADC at 10-15 mm p= 0.013; at 15-20 mm p = 0.008; at 20-25 mm p = 0.010; at 25-30 mm p = 0.017). ROC analyses revealed greatest area under the curve (AUC) for the perifocal normalized Q1 ADC 20-25 mm away from the tumor VOI (AUC = 0.9 [confidence interval = 0.724-1). Normalized average Q1 ADC values (SD) 20-25 mm away from the tumor VOI were respectively 1.05 (0.03) for low-grade and 0.98 (0.05) for high-grade tumors.

Conclusion

Perifocal ADC measurement in gliomas may reflect the magnitude of tumor infiltration beyond the abnormality on conventional MRI. Perifocal ADC measurements could be helpful in determining tumor aggressiveness and thereby potentially guiding patient management.