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Prediction of response to bevacizumab in recurrent high grade glioma using diffusion-weighted imaging

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PURPOSE: Bevacizumab, monoclonal antibody for vascular endothelial growth factor, is a novel treatment for recurrent high-grade gliomas (rHGG). However, only a subset of patients experience response to bevacizumab and prolonged survival. Therefore, adequate predictor for tumor response and survival after bevacizumab has been required. The purpose of our study was to assess the value of diffusion-weighted imaging (DWI) in predicting reponse to bevacizumab.

MATERIALS AND METHODS: A total of 29 patients who underwent bevacizumab therapy for rHGG between October 2007 and May 2011 were included for our retrospective study (GBM = 22, AA = 7; mean age 51.2 years; Male = 20, Female = 9). All patients performed conventional MRI with DWI before and 1–2 months (mean: 38.0 days) after bevacizumab treatment. Following analysis was performed for each MRI before and after initial bevacizumab dose. Manual segmentation of ADC map derived from DWI was performed for the corresponding area with T2 hyperintense area and total segmented volume (H_{T2}) were calculated. After measuring ADC value of normal cerebral cortex, volume of foci with lower ADC value than normal cortex (L_{ADC}) was calculated, and the proportion of L_{ADC} to H_{T2} (L_{ADC}/H_{T2}) was also calculated. Based on these volumetric data, changes in H_{T2}, L_{ADC} and L_{ADC}/H_{T2} between before and after bevacizumab treatment were also derived. Thereafter, those volumetric data were compared to progression free survival (PFS) as defined by Response Assessment Neuro-Oncology Working Group criteria.

RESULTS: We found a statistically significant negative correlation between PFS and L_{ADC} value of post-bevacizumab ADC map ($r = -0.413$, $p = .026$). The rHGGs of less than L_{ADC} of 2.5 cm^3 showed longer PFS than those with 2.5 cm^3 or larger than L_{ADC} of 2.5 cm^3 (median 135 vs. 91 days) ($p = .002$) on post-bevacizumab ADC maps. On stepwise multiple regression analysis, only post-bevacizumab L_{ADC} was identified as the significant factor for PFS.

CONCLUSION: We found the significant correlation between PFS and post-bevacizumab L_{ADC} in rHGGs treated with bevacizumab, which suggests that the volume of foci with diffusion restriction, high cellular portion, on post-bevacizumab MRI can predict the response to bevacizumab .