ABSTRACT

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Distinguishing Tumor Recurrence From Radiation Necrosis in Treated Glioblastoma Using Multiparametric MRI.

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PURPOSE: The purpose of this study was to evaluate the diagnostic performance of single-parameter, unimodal and bimodal magnetic resonance imaging (MRI) in differentiating tumor recurrence (TR) from radiation necrosis (RN) in patients with glioblastoma (GBM) after treatment using diffusion-weighted imaging (DWI), diffusion tensor imaging (DTI), dynamic susceptibility contrast enhancement-perfusion weighted imaging (DSC-PWI), and proton magnetic resonance spectroscopy (1H-MRS).

MATERIALS AND METHODS: Patients with histologically proven GBM who underwent surgical intervention followed by chemoradiotherapy and developed a new, progressively enhanced lesion on follow-up MRI were included in our study. Subsequently, DWI, DTI, DSC-PWI, and 1H-MRS were performed. Then, these patients underwent a second surgical operation or follow-up MRI to prove TR or RN. MRI metrics include apparent diffusion coefficient (ADC) and relative ADC (rADC) values derived from DWI; fractional anisotropy (FA), axial diffusion coefficient (DA) and radial diffusion coefficient (DR) values derived from DTI; and relative cerebral blood volume (rCBV) and relative cerebral blood flow (rCBF) derived from DSC-PWI. Spectral metabolites such as choline (Cho), creatine (Cr), N-acetylaspartate (NAA), lactate (Lac), and lipids (Lip) were derived from MRS, and the ratios of these metabolites were calculated, including Cho/NAA, Cho/Cr, NAA/Cr, Lac/Cr, and Lip/Cr. These indices were compared between the TR group and RN group, and the receiver operating characteristic (ROC) curve was used to evaluate the performance in distinguishing TR from RN by using single-parameter, unimodal and bimodal MRI.

RESULTS: There were significant differences between the TR and RN groups in terms of ADC ($p = 0.001$), rADC ($p < 0.001$), FA ($p = 0.001$), DA ($p = 0.003$), DR ($p = 0.003$), rCBV ($p < 0.001$), rCBF ($p < 0.001$), Cho/NAA ($p < 0.001$), Lac/Cr ($p < 0.001$) and Lip/Cr ($p < 0.001$). ROC analysis suggested that rCBV, MRS, and DSC + MRS were the optimal single-parameter, unimodal, and bimodal MRI classifiers for distinguishing TR from RN, with AUC values of 0.909, 0.940, and 0.994, respectively.

CONCLUSION: The combination of parameters based on multiparametric MRI in the region of enhanced lesions is a valuable noninvasive tool for discriminating TR from RN.

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