Toward Distinguishing Recurrent Tumor From Radiation Necrosis: DWI and MTC in a Gamma Knife-Irradiated Mouse Glioma Model.


Abstract

Accurate noninvasive diagnosis is vital for effective treatment planning. Presently, standard anatomical magnetic resonance imaging (MRI) is incapable of differentiating recurring tumor from delayed radiation injury, as both lesions are hyperintense in both postcontrast T1- and T2-weighted images. Further studies are therefore necessary to identify an MRI paradigm that can differentially diagnose these pathologies. Mouse glioma and radiation injury models provide a powerful platform for this purpose.

METHODS AND MATERIALS: Two MRI contrasts that are widely used in the clinic were chosen for application to a glioma/radiation-injury model: diffusion weighted imaging, from which the apparent diffusion coefficient (ADC) is obtained, and magnetization transfer contrast, from which the magnetization transfer ratio (MTR) is obtained. These metrics were evaluated longitudinally, first in each lesion type alone—glioma versus irradiation—and then in a combined irradiated glioma model.

RESULTS: MTR was found to be consistently decreased in all lesions compared to nonlesion brain tissue (contralateral hemisphere), with limited specificity between lesion types. In contrast, ADC, though less sensitive to the presence of pathology, was increased in radiation injury and decreased in tumors. In the irradiated glioma model, ADC also increased immediately after irradiation, but decreased as the tumor regrew.

CONCLUSIONS: ADC is a better metric than MTR for differentiating glioma from radiation injury. However, MTR was more sensitive to both tumor and radiation injury than ADC, suggesting a possible role in detecting lesions that do not enhance strongly on T1-weighted images.

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PMID: 25104071 [PubMed - as supplied by publisher]