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Assessment of therapeutic response and treatment planning for brain tumors using metabolic and physiological MRI.

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Abstract

MRI is routinely used for diagnosis, treatment planning and assessment of response to therapy for patients with glioma. Gliomas are spatially heterogeneous and infiltrative lesions that are quite variable in terms of their response to therapy. Patients classified as having low-grade histology have a median overall survival of 7 years or more, but need to be monitored carefully to make sure that their tumor does not upgrade to a more malignant phenotype. Patients with the most aggressive grade IV histology have a median overall survival of 12-15 months and often undergo multiple surgeries and adjuvant therapies in an attempt to control their disease. Despite improvements in the spatial resolution and sensitivity of anatomic images, there remain considerable ambiguities in the interpretation of changes in the size of the gadolinium-enhancing lesion on T(1) -weighted images as a measure of treatment response, and in differentiating between treatment effects and infiltrating tumor within the larger T(2) lesion. The planning of focal therapies, such as surgery, radiation and targeted drug delivery, as well as a more reliable assessment of the response to therapy, would benefit considerably from the integration of metabolic and physiological imaging techniques into routine clinical MR examinations. Advanced methods that have been shown to provide valuable data for patients with glioma are diffusion, perfusion and spectroscopic imaging. Multiparametric examinations that include the acquisition of such data are able to assess tumor cellularity, hypoxia, disruption of normal tissue architecture, changes in vascular density and vessel permeability, in addition to the standard measures of changes in the volume of enhancing and nonenhancing anatomic lesions. This is particularly critical for the interpretation of the results of Phase I and Phase II clinical trials of novel therapies, which are increasingly including agents that are designed to have anti-angiogenic and anti-proliferative properties as opposed to having a direct effect on tumor cell viability. Copyright © 2011 John Wiley & Sons, Ltd.

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