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Magnetic resonance imaging techniques for monitoring glioma response to chemoradiotherapy

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Abstract

Purpose: Treatment response assessment for gliomas currently uses changes in tumour size as measured with T_1- and T_2-weighted MRI. However, changes in tumour size may occur many weeks after therapy completion and are confounded by radiation treatment effects. Advanced MRI techniques sensitive to tumour physiology may provide complementary information to evaluate tumour response at early timepoints during therapy. The objective of this review is to provide a summary of the history and current knowledge regarding advanced MRI techniques for early treatment response evaluation in glioma.

Methods: The literature survey included perfusion MRI, diffusion-weighted imaging, quantitative magnetization transfer imaging, and chemical exchange transfer MRI. Select articles spanning the history of each technique as applied to treatment response evaluation in glioma were chosen. This report is a narrative review, not formally systematic.

Results: Chemical exchange saturation transfer imaging potentially offers the earliest method to detect tumour response due to changes in metabolism. Diffusion-weighted imaging is sensitive to changes in tumour cellularity later during radiotherapy and is prognostic for progression-free and overall survival. Substantial evidence suggests that perfusion MRI can differentiate between tumour recurrence and treatment effect, but consensus regarding acquisition, processing, and interpretation is still lacking. Magnetization transfer imaging shows promise for detecting subtle white matter damage which could indicate tumour invasion, but more research in this area is needed.

Conclusion: Advanced MRI techniques show potential for early treatment response assessment, but each technique alone lacks specificity. Multiparametric imaging may be necessary to aid biological interpretation and enable treatment guidance.

Keywords: Chemical exchange saturation transfer; Glioma; Magnetic resonance imaging; Quantitative imaging; Response assessment.