The Differentiation between Progressive Disease and Treatment-Induced Effects with Perfusion-Weighted Arterial Spin-Labeling in High-Grade Gliomas

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Abstract

Background and purpose: Treatment-induced effects are difficult to differentiate from progressive disease in radiologically progressing diffuse gliomas after treatment. This retrospective, single-center cohort study investigated the diagnostic value of arterial spin-labeling perfusion in differentiating progressive disease from treatment-induced effects in irradiated patients with a high-grade glioma.

Materials and methods: Adults with a high-grade glioma diagnosed between January 1, 2012, and December 31, 2018, with a new or increasing contrast-enhancing lesion after radiotherapy with or without chemotherapy and arterial spin-labeling were consecutively included. Arterial spin-labeling is part of the routine follow-up examinations of patients with a high-grade glioma. The outcomes of progressive disease or treatment-induced effects were defined after histologic or >6 weeks radiologic follow-up. Two neuroradiologists graded the arterial spin-labeling visually as negative (hypointense to gray matter) or positive (iso-/hyperintense). Additionally, the arterial spin-labeling signal intensity in the enhancing lesion was compared quantitatively with that in the contralateral normal brain. Diagnostic test properties and the Cohen κ inter- and intrarater reliability were determined. We present data according to the time after radiation therapy.

Results: We included 141 patients with 173 lesions (median age, 63 years). Ninety-four (54%) lesions showed treatment-induced effects, and 79 (46%), progressive disease. For visual analysis, the ORs of an arterial spin-labeling positive for progressive disease in the group with progression within 3, between 3 and 6, and after 6 months after radiation therapy were 0.65 (95% CI, 0.28-1.51; P = .319), 3.5 (95% CI, 0.69-17.89; P = .132), and 6.8 (95% CI, 1.48-32; P = .014). The areas under the curve were 0.456, 0.652, and 0.719. In quantitative analysis, the areas under the curve were 0.520, 0.588, and 0.587 in these groups. Inter- and intrarater reliability coefficients were 0.67 and 0.62.

Conclusions: Arterial spin-labeling performed poorly in differentiating progressive disease from treatment-induced effects in high-grade gliomas within 6 months after radiation therapy, with fair performance after this period. Arterial spin-labeling may need to be combined with other imaging features and clinical information for better performance.

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