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How can we differentiate supratentorial tumor recurrence from postradiation imaging changes in children treated for primary malignant brain tumors?

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Abstract

Objective: Distinguishing tumor recurrence from therapy-induced imaging changes (TIIC) on brain MRI in children treated for primary malignant brain tumors may be challenging. The authors aimed to assess the diagnostic ability of multimodal MRI in differentiating TIIC from tumor recurrence.

Methods: The authors retrospectively included children with abnormal supratentorial brain MRI findings after treatment for primary malignant brain tumors (regardless of their localization) with complete resection and radiotherapy. A total of 18 patients with TIIC and 25 patients with tumor recurrence were compared, according to structural, apparent diffusion coefficient (ADC), and arterial spin labeling (ASL) imaging data accrued over time. TIIC were defined by a new MRI scan that was stable for at least 1 year or had regressed, or by histopathology findings in specimens obtained when the anomaly was surgically treated.

Results: The time interval between completion of radiotherapy and the appearance of abnormal brain MRI findings was significantly shorter in the TIIC group compared with the tumor recurrence group (median 6 vs 35 months; $p < 0.001$). TIIC appeared as foci of increased T2-weighted signal intensity, without nodule, associated with variable contrast enhancement. Tumor recurrence appeared as a well-defined nodule with intermediate signal intensity on T2-weighted images with nodular contrast enhancement. Relative ADC values were significantly higher in the TIIC group (median 1.43 vs 0.88; $p < 0.001$). Relative ASL-cerebral blood flow (CBF) values were significantly lower in the TIIC group (median 0.27 vs 0.43; $p = 0.04$). On follow-up MRI, TIIC could progress, regress, or remain stable. In most instances (72%), they decreased in size or remained stable at 4 years of follow-up.

Conclusions: MRI features of TIIC include foci of increased signal intensity without a demonstrable nodule on T2-weighted images, high ADC values, and lower ASL-CBF values, whereas tumor recurrence appears as a well-defined nodule with low ADC values and higher ASL-CBF values.

Keywords: MRI; brain tumor; oncology; pediatric; radiation treatment effect; recurrence.