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Histopathological correlation of brain tumor recurrence vs. radiation effect post-radiosurgery as detected by MRI contrast clearance analysis: a validation study

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Abstract

Purpose: The differentiation between adverse radiation effects (ARE) and tumor recurrence or progression (TRP) is a major decision-making point in the follow-up of patients with brain tumors. The advent of immunotherapy, targeted therapy and radiosurgery has made this distinction difficult to achieve in several clinical situations. Contrast clearance analysis (CCA) is a useful technique that can inform clinical decisions but has so far only been histologically validated in the context of high-grade gliomas.

Methods: This is a series of 7 patients, treated between 2018 and 2023, for various brain pathologies including brain metastasis, atypical meningioma, and high-grade glioma. MRI with contrast clearance analysis was used to inform clinical decisions and patients underwent surgical resection as indicated. The histopathology findings were compared with the CCA findings in all cases.

Results: All seven patients had been treated with gamma knife radiosurgery and were followed up with periodic MR imaging. All patients underwent CCA when the necessity to distinguish tumor recurrence from radiation necrosis arose, and subsequently underwent surgery as indicated. Concordance of CCA findings with histological findings was found in all cases (100%).

Conclusions: Based on prior studies on GBM and the surgical findings in our series, delayed contrast extravasation MRI findings correlate well with histopathology across a wide spectrum of brain tumor pathologies. CCA can provide a quick diagnosis and have a direct impact on patients' treatment and outcomes.

Keywords: Brain tumors; Contrast clearance analysis; Histopathology; Radiation necrosis; Tumor progression.

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