Using intraoperative dynamic contrast-enhanced T1-weighted MRI to identify residual tumor in glioblastoma surgery.

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Abstract
Object The goal of surgery in high-grade gliomas is to maximize the resection of contrast-enhancing tumor without causing additional neurological deficits. Intraoperative MRI improves surgical results. However, when using contrast material intraoperatively, it may be difficult to differentiate between surgically induced enhancement and residual tumor. The purpose of this study was to assess the usefulness of intraoperative dynamic contrast-enhanced T1-weighted MRI to guide this differential diagnosis and test it against tissue histopathology. Methods Preoperative and intraoperative dynamic contrast-enhanced MRI was performed in 21 patients with histopathologically confirmed WHO Grade IV gliomas using intraoperative 3-T MRI. Standardized regions of interest (ROIs) were placed manually at 2 separate contrast-enhancing areas at the resection border for each patient. Time-intensity curves (TICs) were generated for each ROI. All ROIs were biopsied and the TIC types were compared with histopathological results. Pharmacokinetic modeling was performed in the last 10 patients to confirm nonparametric TIC analysis findings. Results Of the 42 manually selected ROIs in 21 patients, 25 (59.5%) contained solid tumor tissue and 17 (40.5%) retained the brain parenchymal architecture but contained infiltrating tumor cells. Time-intensity curves generated from residual contrast-enhancing tumor and their preoperative counterparts were comparable and showed a quick and persistently increasing slope ("climbing type"). All 17 TICs obtained from regions that did not contain solid tumor tissue were undulating and low in amplitude, compared with those obtained from residual tumors ("low-amplitude type"). Pharmacokinetic findings using the transfer constant, extravascular extracellular volume fraction, rate constant, and initial area under the curve parameters were significantly different for the tumor mass, nontumoral regions, and surgically induced contrast-enhancing areas. Conclusions Intraoperative dynamic contrast-enhanced MRI provides quick, reproducible, high-quality, and simply interpreted dynamic MR images in the intraoperative setting and can aid in differentiating surgically induced enhancement from residual tumor.

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