Use of magnetic perfusion-weighted imaging to determine epidermal growth factor receptor variant III expression in glioblastoma.

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Abstract

Identification of the epidermal growth factor receptor variant III (EGFRvIII) mutation in glioblastoma has become increasingly relevant in the optimization of therapy. Traditionally, determination of tumor EGFRvIII-expression has relied on tissue-based diagnostics. Here, we assess the accuracy of magnetic resonance perfusion-weighted imaging (MR-PWI) in discriminating the EGFRvIII-expressing glioblastoma subtype. We analyzed RNA from 132 primary human glioblastoma tissue samples by reverse-transcription polymerase chain reaction (RT-PCR) for the EGFRvIII and EGFR wild-type mutations and by quantitative RT-PCR for expression of vascular endothelial growth factor (VEGF). Concurrently, 3 independent observers reviewed preoperative 1.5-Tesla (T)/SE or 3.0-Tesla (T)/GE MR perfusion images to determine the maximum relative tumor blood volume (rTBV) of each of these tumors. EGFRvIII-expressing glioblastomas showed significantly higher rTBV, compared with those tumors lacking EGFRvIII expression. This association was observed in both the 1.5T/SE (P = .000) and 3.0T/GE (P = .001) cohorts. By logistic regression analysis, combining the 2 MR system cohorts, rTBV was a very strong predictor of EGFRvIII mutation (odds ratio [rTBV] = 2.70; P = .000; McFadden's ρ(2) = 0.23). Furthermore, by receiver-operating characteristic curve analysis, rTBV discriminated EGFRvIII with very high accuracy (A(z) = 0.81). In addition, we found that VEGF upregulation was associated, although without reaching statistical significance, with EGFRvIII expression (P = .16) and with increased rTBV (F-ratio = 2.71; P = .102). These trends suggest that VEGF-mediated angiogenesis may be a potential mediator of angiogenesis to increase perfusion in EGFRvIII-expressing glioblastomas, but there are likely several other contributing factors. This study demonstrates the potential to use rTBV, a MR-PWI-derived parameter, as a noninvasive surrogate of the EGFRvIII mutation.