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Vessel size and perfusion-derived vascular habitat refines prediction of treatment failure to bevacizumab in recurrent glioblastomas: validation in a prospective cohort

Minjae Kim [1 2], Ji Eun Park [3], Shin Kyo Yoon [4], Nakyoung Kim [5], Young-Hoon Kim [6], Jeong Hoon Kim [6], Ho Sung Kim [1]

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Abstract

Objectives: Anti-angiogenic therapy may not benefit all patients with recurrent glioblastomas, and imaging biomarker predicting treatment response to anti-angiogenic therapy is currently limited. We aimed to develop and validate vascular habitats based on perfusion and vessel size to predict time to progression (TTP) in patients with recurrent glioblastomas treated with bevacizumab.

Methods: Sixty-nine patients with recurrent glioblastomas treated with bevacizumab who underwent pretreatment MRI with dynamic susceptibility contrast imaging and vessel architectural imaging were enrolled. Vascular habitats were constructed using vessel size index (VSI) and relative cerebral blood volume (rCBV). Associations with vascular habitats and TTP were analyzed using Cox proportional hazard regression analysis. In a prospectively enrolled validation cohort consisting of 15 patients (ClinicalTrials.gov identifier; NCT04143425), stratification of TTP was demonstrated by the Kaplan-Meier method (log-rank test) using vascular habitats.

Results: Three vascular habitats consisting of high, intermediate, and low angiogenic habitats were identified with rCBV and VSI. Both high angiogenic and intermediate angiogenic habitats were significantly associated with a shorter TTP (hazard ratio [HR], 2.78 and 1.82, respectively; largest p = .003) and so was rCBV (HR, 2.15; p = .02). Concordance probability index of vascular habitat combining high and intermediate angiogenic habitats was 0.74. Vascular habitats stratified patients as good or poor responder in a prospective cohort (p = .059).

Conclusions: Perfusion- and vessel size-derived vascular habitats predicted TTP in recurrent glioblastomas treated with anti-angiogenic therapy and aided patient stratification in a prospective validation cohort.

Trial registration: ClinicalTrials.gov identifier: NCT04143425 KEY POINTS: • High and intermediate angiogenic habitats predicted TTP in recurrent glioblastomas treated with anti-angiogenic therapy. • Vascular habitats combining high and intermediate angiogenic habitats aided patient stratification for anti-angiogenic therapy in recurrent glioblastomas.

Keywords: Bevacizumab; Glioblastoma; Perfusion imaging; Treatment outcome.

Comment in

Predictive value of MRI features on glioblastoma.

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