

ABSTRACT 1

Relationship between MR Imaging Features, Gene Expression Subtype, and Histopathologic Features of Glioblastomas

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1. Purpose

To investigate imaging characteristics of primary glioblastomas that predict gene expression subtype and/or microscopic histopathologic features.

2. Materials & Methods

As part of The Cancer Genome Atlas (TCGA) MRI characterization project of the National Cancer Institute (NCI), at least 3 neuroradiologists (from a panel of 6) independently reviewed each MRI of 75 glioblastoma patients in the TCGA database. All images were evaluated according to 26 imaging features (VASARI feature set, <https://wiki.nci.nih.gov/display/CIP/VASARI>). Multireader assessment of each tumor was reduced to a single score for each feature.

Sixty-nine of the tumors were classified as Proneural, Neural, Classic, or Mesenchymal based on gene expression (Verhaak, Cancer Cell 17, 90-110, 2010). As Proneural classification is associated with improved outcome, the groups were reduced to “Proneural” versus “non-Proneural.” Also, 28 biopsy specimens from these tumors were rated independently on the basis of digitized pathologic slides by 2 neuropathologists (from among a panel of 8). Each of 18 features (e.g., microvascular hyperplasia) was rated as absent, present, or abundant. For initial assessment, the pathology ratings were reduced to 2 groups – “absent” versus “present/abundant”.

Associations of the 26 VASARI features with gene expression subtype and the 18 histopathologic features were investigated using Fisher’s exact test and Student’s t-test.

3. Results

Fisher’s exact test demonstrated a significant association between minimal enhancing tumor ($\leq 5\%$ proportion of the overall tumor) and Proneural classification ($p=0.0006$). It also demonstrated a significant association between a $>5\%$ proportion of necrosis and the presence of microvascular hyperplasia in pathology slides ($p=0.008$).

Student’s t-test demonstrated a difference in the mean maximum tumor dimension (based on T2 signal) of tumors with absent microvascular hyperplasia versus tumors with present/abundant microvascular hyperplasia ($p=0.001$), 61 mm versus 86 mm, respectively. This suggests that larger tumor size relates to the presence of microvascular hyperplasia.

No other significant associations were found.

4. Conclusion

These results suggest an association between Proneural subtype of glioblastoma and smaller proportion of tumor enhancement. Overall tumor size and proportion of necrosis (derived from MR images) were associated with the presence of microvascular hyperplasia. This supports the observation that hypoxia related to necrosis induces microvascular hyperplasia.