Computer-aided Visual Image Analysis of Glioblastomas and Genomic Features

E-Mail: snhwang@alum.mit.edu Primary Category: Neuroradiology/Head and Neck
Secondary Category: Brain: Neoplastic Computer-aided Visual Image Analysis of
Glioblastomas and Genomic Features *S N Hwang, PhD,MD, Atlanta, GA; C A Holder,
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PURPOSE
Investigate quantitative computer-aided and qualitative visual imaging characteristics of
primary glioblastomas that may predict genomic features.

METHOD AND MATERIALS
As part of The Cancer Genome Atlas (TCGA) MRI characterization project of the
National Cancer Institute (NCI), methods for image analysis were developed as macros
for NIH ImageJ. Preprocessing with 3D Slicer (software partially sponsored by
NIH/NCI) included anisotropic diffusion noise reduction, N4 intensity inhomogeneity
correction, and image co-registration. Measurements included volumes and surface areas
of enhancing, nonenhancing, and necrotic tumor. At least 3 neuroradiologists
independently reviewed MRI scans of 75 glioblastoma patients in the TCGA database on
the basis of 26 imaging features (VASARI,
https://wiki.nci.nih.gov/display/CIP/VASARI). Tumors were classified as Proneural,
Neural, Classic, or Mesenchymal subtypes based on gene expression. Proneural subtype
is associated with improved outcome. Genomic data were obtained from TCGA's
publicly available information, including mutation status (e.g. TP53 gene). Subgroups
were identified based on copy number data (e.g. CDKN2A homozygous deletions).

RESULTS
Proneural tumors had smaller volume of necrosis by computer-aided measurements
($p=0.04$). A suggestion that Proneural tumors have smaller enhancing tumor volume
($p=0.06$) supports an association between minimal enhancing tumor ($\leq 5\%$ proportion of
the overall tumor) and Proneural classification ($p=0.0006$), as qualitatively assessed by
neuroradiologists. Mesenchymal tumors were also associated with higher necrosis
volume ($p=0.05$). A suggested association between larger necrosis volume and CDKN2A
homozygous deletion ($p=0.07$) was noted. Morphology may also be an important feature,
since Classic glioblastomas had greater surface area to volume ratio of enhancing tumor
($p=0.002$).

CONCLUSION
Quantitative computer-aided measurements and qualitative visual assessment of
glioblastomas are associated with certain genomic features. In particular, Proneural
classification is associated with decreased necrosis, and possibly with smaller enhancing
tumor volume.

CLINICAL RELEVANCE/APPLICATION

A combination of quantitative computer-aided measurements and radiologist qualitative assessment of glioblastomas may be potentially helpful in predicting genomic features and clinical outcome.A combi

FIGURE (OPTIONAL)

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