Prognostic Histomic and Radiomic Analysis of Gliomas using ITCR Funded Tools

Hugo Aerts
John Quackenbush
U24CA194354

David Gutman
Lee Cooper
U24CA194362

HARVARD MEDICAL SCHOOL
EMORY UNIVERSITY SCHOOL OF MEDICINE
Prognostic classification of diffuse gliomas

2016 WHO Classification

- **IDH mutation**
  - (N) IDH wild-type astrocytoma
  - (N) 1p19q co-deletion
  - (Y) IDH mutant astrocytoma
- **Molecular subtype**
  - IDH mutant astrocytoma
  - Oligodendroglia

Histologic grade

- II
- III
- IV
- NA

Better outcome

*Histologic grading is highly subjective but a significant determinant of treatment*
Histomics – modeling histologic characteristics

Grading criteria

- Mitoses
- Pleomorphism
- Microvascular proliferation
- Necrosis

Nuclear pleomorphism


Measuring microvascular phenotypes

https://www.nature.com/articles/s41598-017-15092-3
Histomics – survival convolutional networks

Survival convolutional network

High power field (20X objective)

Convolution

Pooling

Prediction error (negative log-likelihood)

Cox model

Patient survival

Visualizing risk predictions

TCGA-DB-5273 (IDH-mut astrocytoma)

Early microvascular proliferation

1

2

3
Methods: Volumetric delineations

- Grossmann et al, BMC Cancer 2016
*n=96 GBM patients from TCGA-GBM cohort
TP53 positive/negative

TP53 mutated tumors had significantly smaller CE and necrotic volumes \((p=0.012\) and 0.017, respectively) compared to wild-type.

*Gutman et al. Neuro-Radiology 2015*
Volumetric features predict mutational status in GBM patients

n=76 GBM patients from TCGA-GBM cohort

*Gutman et al. Neuro-Radiology 2015
Fundamental Questions in the Supplement

1. What quantitative histomic and radiomic features have independent prognostic value?

2. What is the best way to further stratify outcomes within molecular subtypes?

3. What are the molecular signatures of prognostic histomic and radiomic features?

Radiomic Features + Histomic Features + Molecular Features = Improved Prognostication