Prognostic Value of Imaging-Based Estimates of Glioma Pathology Pre- and Post-Surgery

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INTRODUCTION

Any high grade tumor present within a glioma causes poor prognosis.

This project has two main goals:

1) Estimate the **local** proliferative activity in gliomas.

2) Show resecting highly proliferative tumor improves survival.

Hypothesis: Removing highly proliferative tumor will improve overall survival

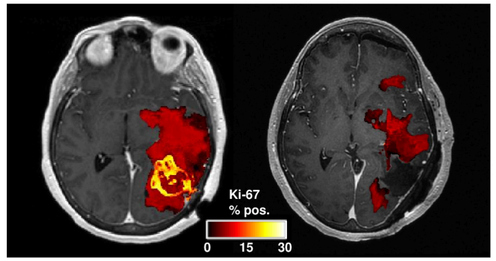


Figure 1: Predicted maps of proliferative activity in a glioma

MODEL APPLIED TO NEW PATIENTS

Biomarker generalization in two independent patient cohorts:

1. 140 high-grade glioma cases from the 2018 BraTS challenge[2]
2. 68 previously untreated high-grade glioma patients from MD Anderson

Table 1: Groups of patients used in this study.

	23 glioma patients in the original clinical trial	1. BraTS challenge cases	2. Historical cases
Image guided tissue biopsies	✓	✗	✗
Preoperative MRI	✓	✓	✓
Postoperative MRI	✓	✗	✓
Outcome data	✗	✓	✓
Analysis	Train proliferation prediction models	Correlate preop proliferation predictions with survival	Measure benefit from removing high proliferation tumor

SURVIVAL RESULTS

Highly proliferative tumor was defined as: >28.2% Ki-67 (cohort 1) and >24.75% Ki-67 (cohort 2).

Any high proliferation preop or postop led to worse survival.

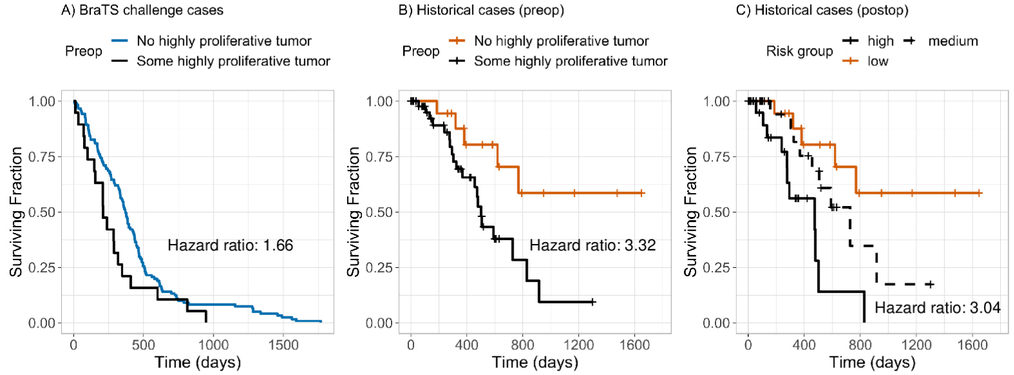
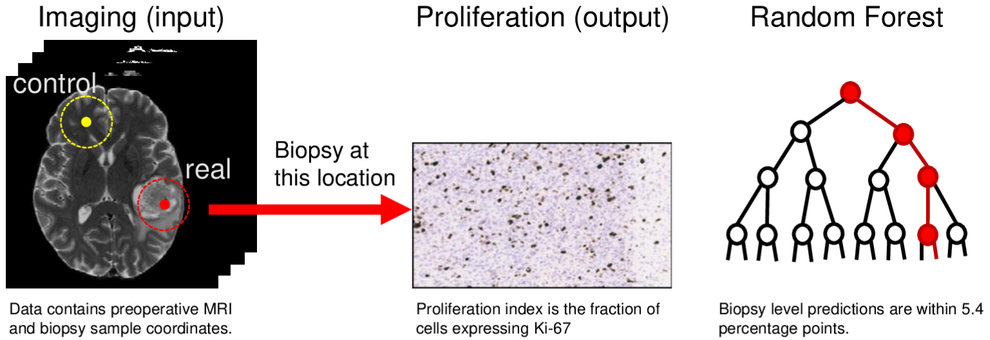


Figure 2: Survival curves for BraTS cases (A) and historical cases (B, C)

Table 2: risk groups in Figure 2C)

		Pre-op high proliferation: no	Pre-op high proliferation: yes
Post-op high proliferation	no	Low risk	Medium risk
	yes	-	High risk

PROLIFERATION PREDICTING MODEL[1]



Data contains preoperative MRI and biopsy sample coordinates.

Proliferation index is the fraction of cells expressing Ki-67

Biopsy level predictions are within 5.4 percentage points.

CONCLUSIONS

- We can predict highly proliferative tumor using routine brain MRI.
- Targeting highly proliferative tumor improves overall survival and is more focused than reducing bulk tumor volume.

FUTURE WORK

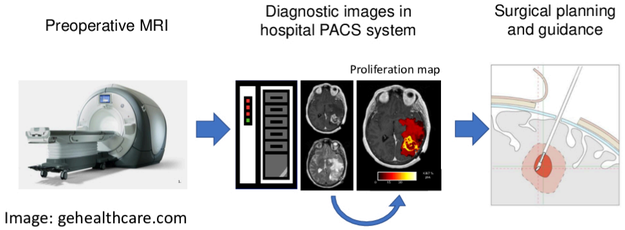


Image: gehealthcare.com

Figure 3: Proliferative activity maps can be generated from routine MR imaging and integrated into the PACS system for surgical planning and guidance.

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