Survival Prediction in Glioblastoma Patients Using Multi-parametric MRI Biomarkers and Machine Learning Methods

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Authors:
H Akbari¹, L Macyszyn¹, J Pisapia¹, X Da¹, M Attiah¹, Y Bi², S Pal³, R Davuluri², L Roccograndi¹, N Dahmane¹, R Wolf¹, M Bilello¹, D O'Rourke⁴, C Davatzikos¹

Institutions:
¹University of Pennsylvania, Philadelphia, PA, ²Northwestern University, Chicago, IL, ³Wistar Institute, Philadelphia, PA, ⁴Hospital of the University of Pennsylvania, Philadelphia, PA

Purpose:
The goal of this study is to undertake an exploratory multiparametric MRI analysis to identify prognostic factors for survival in adult patients with glioblastoma, and to employ advanced computational methods for multiparametric imaging pattern analysis to extract distinctive imaging biomarkers predictive of an individual patient’s prognosis and which might assist in personalized treatment.

Materials and Methods:
This research consists of a retrospective cohort of 105 de novo glioblastoma followed by a prospective study of 29 patients. Preoperative multiparametric MRI data (T1, T1-Gad, T2, T2-FLAIR, rCBV, DTI, and DSC-MRI) were employed to extract imaging biomarkers and to create a model to predict survival using a machine learning method in a cross-validated retrospective cohort study. Subsequently, this model was utilized in the prospective cohort study. Size of tumor and edema, diffusion time, location of tumor, and distribution of intensities of all modalities in each region were utilized through a feature selection method to build the model.

Results:
This method predicted patients who survive less than 6 months with an accuracy of 88% and AUC of 0.87 and patients that survive more than 18 months with an accuracy of 89% and AUC of 0.91 in the retrospective study. In the prospective study, survival less than 6 months with accuracy of 83% and AUC of 0.85 and survival more than 18 months with accuracy of 83% and AUC of 0.84 were predicted. Kaplan-Meier survival curves for patients who survive less than 6 months, 6-18 months, or more than 18 months based on the method prediction resulted in hazard ratios of 18.91 (95% CI: 8.80-40.65) and 4.66 (95% CI: 2.49-8.73).

Conclusions:
Multiparametric image analysis extracts subtle but informative biomarkers correlated to the survival of glioblastoma patients. The most accurate survival prediction can be obtained only through multiparametric imaging pattern analysis, while it would otherwise not be appreciated by examining individual features.

Awards:
Dyke Award
Trainee Award

Categories:
ADULT BRAIN, Neoplasms