Multiparametric MRI-based differentiation of WHO grade II/III glioma and WHO grade IV glioblastoma.

Non-invasive, imaging-based examination of glioma biology has received increasing attention in the past couple of years. To this end, the development and refinement of novel MRI techniques, reflecting underlying oncogenic processes such as hypoxia or angiogenesis, has greatly benefitted this research area. We have recently established a novel BOLD (blood oxygenation level dependent) based MRI method for the measurement of relative oxygen extraction fraction (rOEF) in glioma patients. In a set of 37 patients with newly diagnosed glioma, we assessed the performance of a machine learning model based on multiple MRI modalities including rOEF and perfusion imaging to predict WHO grade. An oblique random forest machine learning classifier using the entire feature vector as input yielded a five-fold cross-validated area under the curve of 0.944, with 34/37 patients correctly classified (accuracy 91.8%). The most important features in this classifier as per bootstrapped feature importance scores consisted of standard deviation of T1-weighted contrast enhanced signal, maximum rOEF value and cerebral blood volume (CBV) standard deviation. This study suggests that multimodal MRI information reflects underlying tumor biology, which is non-invasively
detectable through integrative data analysis, and thus highlights the potential of such integrative approaches in the field of radiogenomics.