Project 1: Neuroimaging Markers for Predicting Outcome of Brain Tumor Surgery

ABSTRACT

Surgical resection is one of the primary treatments for human gliomas, and a growing number of studies have demonstrated the benefits of maximal safe resection for patient survival. However, the decision of surgical resection of tumor-infiltrated brain tissue is often difficult given the risk of inducing neurological deficits. Tumors with ill-defined boundaries that invade and/or infiltrate eloquent areas are often incompletely resected or deemed inoperable for fear of conferring a debilitating deficit. Nonetheless, it is increasingly acknowledged that the functional anatomy of the human neocortex is plastic. Dramatic reorganization of functional brain regions, such as language cortices, have been seen in patients with infiltrating tumors such as gliomas, suggesting such patients with tumors invading functional brain areas may in fact be surgical candidates. Because it has been demonstrated that progression free survival (**PFS**) and overall survival (**OS**) of patients correlate with extent of resection in surgery, patients may benefit from a more aggressive surgical strategy that accounts for the information of functional recovery after surgery, i.e. neural plasticity. The focus of this research project is to develop an intelligent and multimodal strategy for identifying plasticity based on images of brain connectivity that relates to the neurological deficits after surgery in patients with focal brain gliomas involving motor and/or language regions. Three imaging modalities including resting-state functional magnetic resonance imaging, diffusion tensor imaging and navigated transcranial magnetic stimulation (**nTMS**) will be used and integrated to identify new imaging markers. The project has **three Specific Aims**. In patients following surgery for motor/speech area gliomas, we will identify plasticity metrics based on multimodal connectivity mapping and determine the relationship between plasticity metrics and neurological deficits **(Aim 1)** and determine whether baseline connectivity maps and extent of resection can be used to predict plasticity **(Aim 2)**. In addition, we will develop an intelligent, machine learning based model that predicts the probability of long-term deficits and overall survival **(Aim 3)**. The success of this project can demonstrate feasibility of developing a novel multimodal-based quantitative image marker to predict clinical outcome of brain tumor surgery and acquire the solid preliminary data to support the research project leader (**RPL**) to apply for a more comprehensive **NIH R01** project that aims to further optimize and validate the new multimodality imaging technology and prediction model. The **long-term outcomes** of the research effort will lead to a comprehensive understanding of neural plasticity after surgery and develop new quantitative neuroimaging clinical markers based on the machine learning models to assist prediction of PFS or OS of patients. Knowledge of the neural plasticity obtained from this project will serve to leverage the plasticity into surgery planning, which we expect will improve overall survival of patients by increasing the extent of resection, without compromising patient safety or long-term functional outcomes.