Continuation/Research Progression Projects Form (7)

Required for projects that are a continuation/progression in the same field of study as a previous project.
This form must be accompanied by the previous year's abstract and Research Plan/Project Summary.

Student's Name(s) Miles Kim

To be completed by Student Researcher: List all components of the current project that make it new and different from previous research. The information must be on the form; use an additional form for previous year and earlier projects.

Components	Current Research Project	Previous Research Project: Year: 2019
1. Title	Necrosis, Non-Enhancing, and Enhancing Tumor Features of Glioblastoma Tissue for Prediction of Overall Survival and Progression Free Survival	Combining Shape and Textural Features of Cerebral Edema Tissue in Glioblastoma to Predict Overall Survival
2. Change in goal/ purpose/objective	Looks at necrosis, non-enhancing, and enhancing tumor features for prediction of overall survival and progression free survival in glioblastoma.	Looks at cerebral edema features for prediction of overall survival in glioblastoma.
3. Changes in methodology	Used LifeX imaging software, used data from the TCGA-GBM data set	Used ITKSnap software, used data from the BraTs 2019 data set
4. Variable studied	Textural features of necrosis, non-enhancing, and enhancing tumor	Textural features of cerebral edema
5. Additional changes		

Attached are:

☑ Abstract and Research Plan/Project Summary, Year 2019

I hereby certify that the above information is correct and that the current year Abstract & Certification and project display board properly reflect work done only in the current year.

Miles Kim — Student's Printed Name(s)

Miles Kim — Signature

01/15/20 — Date of Signature (mm/dd/yy)

PREVIOUS ABSTRACT
INDIVIDUAL PROJECT
2019

Abstract

Glioblastoma, also known as glioblastoma multiforme, is an aggressive form of brain cancer. Only five-percent of diagnosed patients live for longer than five years, with patients having an overall survival of only 14.2 months. The Stupp Protocol is the standard of care used to treat glioblastoma, and it involves total resection of the tumor, chemotherapy, and radiation. The power of this protocol would be enhanced if we had a more accurate method of measuring the aggressiveness of the cancer. We can develop a more accurate method of measuring this aggressiveness by assessing a patient's predicted overall survival and progression free survival. Linking these measurements to features of the cancer that can be measured by magnetic resonance imaging would allow physicians to estimate the aggressiveness of the cancer according to the characteristics of the cancer. This estimation would enable physicians to adjust levels of chemotherapy and radiation to correspond with the aggressiveness of the cancer, providing for a better chance of survival as well as reduced side effects that could be caused by overtreatment. We wish to examine novel textural features of the peritumoral edema to evaluate their use as clinical outcome predictors. This dataset is comprised of the BraTS 2019 collection. We used T1-weighted contrast enhanced MRI scans for a total of 189 patients. Segmentation algorithms were used to create segmentations for various heterogeneous histologic sub-regions, namely the peritumoral edema. These segmentations were verified by clinical radiologists. Textural readouts created using LifeX software for radiomic feature calculation in multimodality imaging were analyzed using Receiver Operating Characteristic curve (ROC) and Kaplan-Meier analysis. Insignificant differences between diagnostic groups created by each textural parameter were found for peritumoral edema histologic sub-regions.

PREVIOUS PLAN REQUIREMENT (INDIVIDUAL PROJECT 2019

Research Plan

a.) Rationale

In order to allow for the optimized treatment of patients, information about overall survival and progression free survival is essential. Provided with such information, physicians would be able to adjust levels of chemotherapy and radiation to correspond with aggressiveness of glioblastoma. In addition, patients can be comforted, knowing they have accurate information about the time they have left with families and friends.

b.) Hypothesis

Shape and textural features of cerebral edema may be used as biomarkers to predict progression in GBM.

Research Questions

Our aim is to answer the following questions:

1. Are cerebral edema features correlated with poor prognosis?
2. Does this feature have a distinction between high and low overall survival groups?

Expected Outcomes

Analysis of cerebral edema tissue will show that this features is a strong predictor of overall survival in patients with glioblastoma

c.) Procedure

MRI Data of 212 Patients Gathered

From the Center for Biomedical Image Computing & Analytics (CBICA) at the Perelman School of Medicine at the University of Pennsylvania, I requested access to the data from the 2019 Multimodal Brain Tumor Segmentation Challenge. This dataset is comprised of the BraTS 2019 collection. The data consisted of FLAIR, T1-weighted, T1-weighted contrast enhanced, and T2-weighted MRI scans. It also consisted of segmentation of various heterogeneous histologic sub-regions, namely the peritumoral edema, enhancing, and non-enhancing tumor. Segmentation algorithms were used to create the segmentations

Segmentation Masks Drawn

We will use LifeX imaging software, a software for radiomic feature calculation in multimodality imaging that accelerates advances in the characterization of tumor heterogeneity, to analyze the segmentation masks on the images.

Radiomics

LifeX imaging software creates a textural readout from the 3D imaging analysis that provides data on GLCM texture, which measures patterns in combinations of gray levels that occur in an image. Various first order shape features such as sphericity of tumor will also be measured with the software.

Feature Extraction and Survival Group Prediction

Two feature groups will be created, one associated with a low overall survival and one associated with high overall survival. Kaplan–Meier estimate survival curves, log-rank tests, and ROC analysis may be used to compare the two groups. All statistical analysis will be completed using textural readouts from LifeX imaging software and R code software.

Risk and Safety

1. Human Participants Research: N/A

2. Vertebrate Animal Research: N/A

3. Potentially Hazardous Biological Agents Research: N/A

4. Potentially Hazardous Chemicals: N/A

Data Analysis

P values less than .05 will be considered statistically significant. A log-rank test will be used to find the difference between the edema tissue of the low overall survival feature group and high overall survival feature group. ROC analysis will be used to test these features for prediction capability.

References

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