AbstractID: 6782 Title: Beyond SUV: New methods for assessing treatment response in PET images

Purpose: PET use for radiotherapy treatment planning and monitoring has rapidly increased. Accumulating evidence suggests that characteristics of pre-treatment FDG-PET could be utilized as prognostic factors to predict radiotherapy outcomes in different cancer sites. Direct standardized uptake value (SUV) measurements were traditionally used to assess risk. However, such measurements are limited to intensity values irrespective of tumor-microenvironment topological features. To improve our understanding of embedded information in PET, we are investigating new approaches for analyzing and extracting statistically robust candidate variables for predicting post-radiotherapy relative-risk.

Method and Materials: We investigated two approaches for summarizing reliable information from PET images to predict outcomes. The first approach is a generalization of the dose-volume histogram (DVH) concept into functional imaging referred to as intensity-volume histogram (IVH). An IVH would summarize the 3D functional imaging information for any anatomical structure into a single curve. Analogous to its DVH counterpart, intensity-volume metrics are derived. The second approach utilizes extraction of shape and texture features that would characterize the structure of interest. These features enable mimicking of human perception of in terms of geometrical differences and texture variability. The tools are demonstrated on a subset of 14 cervix cancer patients who underwent pre-treatment FDG-PET scanning.

Results: Nineteen candidate features, extracted from delineated tumor volumes, were analyzed for assessment of patients' risk of failure. Our preliminary results indicate that an intensity-volume difference metric and texture energy had the strongest predictive power. A combined multivariable logistic regression model of these two variables yielded a Spearman's correlation of 0.53 ($p=0.02$) and area under ROC curve of 0.8.

Conclusion: We have demonstrated new methods for analyzing functional imaging data. These methods allow for extracting visual cues and metrics that could facilitate incorporation of PET imaging information into assessment predictors of patient's response to radiotherapy treatment.