AbstractID: 11606 Title: Improving Quantitation in Serial PET/CT with Improved Image Registration and Intra-Patient Metabolic Corrections

Purpose: The goal of this study is to explore the use of deformable image registration in conjunction with an internal metabolic reference to improve quantitative treatment response assessment using F18-FDG PET/CT.

Method and Materials: To account for anatomic and positional changes, pre- and post-radiotherapy (RT) PET/CT studies were aligned with a deformable image registration technique to the planning CT (PCT). Consequently, both CT- and PET-based regions-of-interest on all co-registered image sets can be used to determine uptake for the same anatomic volumes. The brainstem, contoured on PCT, was selected as an internal metabolic normalization structure to correct for study dependent variations; particularly, inconsistent injection-to-imaging time. The mean SUV was calculated using a threshold contour (40% of maximum) method, created on the pre-RT PET/CT images. Student's t-tests and receiver operating characteristic (ROC) analyses were performed for metabolically corrected (uptake ratio of tumor to brainstem) and uncorrected mean and maximum SUV.

Results: A statistically detectable separation was improved between responding and non-responding patients using the corrected post-RT mean SUV for the threshold contour ($P=0.017$ vs. $P=0.00$); while no worsening was seen for the maximum SUV ($P<0.00$ vs. $P<0.00$). Reduction of uptake the between pre- and post-RT images was only significant for the maximum SUV ($P=0.033$) and subsequently improved when corrected with the metabolic reference ($P=0.012$). Finally, ROC analysis of the maximum corrected post-RT SUV showed improvement in specificity (94% vs. 85%) and similar results for the sensitivity (83% vs. 83%) level. However, ROC analyses of corrected and uncorrected mean post-RT SUV derived from the threshold contour did not show improvement.

Conclusions: Multiple lines of evidence demonstrate that correction of SUV with an internal metabolic reference may improve the quantitative potential of F18-FDG PET/CT.

Conflict of Interest: Research sponsored by Varian Medical Systems.