AbstractID: 13275 Title: Impact of image acquisition mode and reconstruction parameters on target volume definition uisng PET-thresholded-based segmentation

Purpose: Although PET-threshold-based tumor segmentation has been investigated extensively for target definition in radiotherapy, the sensitivity of this method to quantitative imaging uncertainties is often neglected. This work investigates the impact of image acquisition and reconstruction parameters on tumor volumes defined by PET-threshold-based segmentation.

Method and Materials: Fifteen patients underwent PET/CT on a GE Discovery VCT scanner, 60 minutes post injection of 10mCi of [^{18}F]-FDG. Scans were acquired in both 2D and 3D mode. For each acquisition the grid size, post-reconstruction filter and the number of iterations in the reconstruction algorithm were varied within typical clinical settings. Ten different reconstructed images were created for each patient. Lesions were segmented using thresholds of 40% and 70% of the maximum standardized uptake value, and the corresponding segmented volumes (V_{40} and V_{70}, respectively) were calculated. The range of the segmented volume differences was determined for all images with respect to the image generated using our default reconstruction parameters.

Results: PET acquisition and reconstruction parameters caused extensive changes in V_{40} and V_{70}. For 3D acquisition, the volume difference ranged between -5% to 90% for V_{40} and -10% to 140% for V_{70}. For 2D acquisition, the volume difference ranged between -10 to 75% for V_{40} and -50% to 104% for V_{70}. The maximum difference in segmented tumor volumes observed in the same patient exceeded 150%. Dissimilarities in contour-shape were observed on all images for 40% and 70% thresholds.

Conclusion: A startling degree of variability was observed in PET-thresholded tumors when different acquisition modes and reconstruction parameters were used. These variations alone can lead to volumetric errors greater than 100%. Variability in the target volume due to reconstruction parameters and acquisition modes must be addressed before PET-threshold-based segmentation can be used for target definition in radiotherapy.