Purpose: Gated (4D) PET/CT scans have been shown to be effective in recovering the signal lost due to respiratory motion. Ungated (3D) and 4D FDG-PET scans obtained pre and post radiation therapy (RT) for lung cancer were compared to examine the role of 4D PET in assessing FDG uptake changes due to therapy.
Methods: Sequential 3D and 4D FDG-PET/CT scans were acquired approximately two weeks before (pre-RT) and one month after (post-RT) treatment for patients receiving definitive RT for lung cancer. Targeted lesions were identified for each patient, and a region of interest (ROI) was defined for each lesion on the 3D and each of the five phases of the 4D pre-RT scans. The ROIs were generated using a 40% of the maximum standardized uptake value (SUV) threshold, and the maximum SUV for each lesion from the pre–RT scans was recorded. Pre-RT ROIs were then used to locate the areas of the original FDG uptake on the post-RT scans using rigid registration. A post-RT ROI was generated, and the maximum post-RT SUV was recorded.
Results: Sixteen lesions were identified and analyzed for twelve patients. Comparison of pre-RT to post-RT 3D PET scans showed a median SUV decrease of 62% (range 36-89%), while comparison of pre-RT to post-RT 4D PET scans showed a median SUV decrease of 67% (range 30-89%). The mean difference between the SUV change on 3D versus 4D scans was 4.9% (range 0-15%, p=.07), and the highest quartile had an absolute difference greater than 9% in SUV change.
Conclusion: When assessing SUV changes with PET scans done pre and post-RT, a substantial proportion of lesions had showed differences of over 9% in measurement of SUV change when comparing 3D PET to 4D PET. Such differences could potentially influence classification of PET-based response assessment.