AbstractID: 8632 Title: Automatic segmentation of static and moving target volumes using respiratory ungated (3D) and gated (4D) PET/CT images

Introduction: Thresholding methods are commonly used to segment lesion volumes in PET images. However, the presence of motion makes it difficult to determine the optimum threshold. To measure the threshold needed to produce the true volume of a moving target, we have investigated the effect of respiratory motion on the threshold at varying target-to-background activity concentration ratios (TBRs) using gated (4D) and ungated (3D) PET images.

Materials and Methods: Using a PET/CT scanner with gating capability, spherical targets (0.5–26.5 mL) filled with ^{18}F-FDG in a NEMA IEC body phantom were imaged with both a 3D-PET scan corrected with a 3D-CT attenuation map and a 4D-PET scan corrected with phase-matched 4D-CT maps. . The phantom was either at rest or moving sinusoidally in the *superior-inferior* direction with an amplitude of 2 cm and a period of 4.5 s to simulate respiratory motion. The optimum threshold values which give the true volumes of the spheres were derived from the 3D and 4D-PET images at TBR = 4, 8, and infinite. For the 4D-PET images, 5-bin gating data were used in this analysis.

Results: The TBR-threshold-volume curves show that the optimum threshold exponentially decreases as the volume increases. In addition, the threshold increases as the TBR decreases. The results also illustrate that the threshold values applied to the 4D-PET images for the moving targets are well correlated with the optimum threshold values applied to the 3D-PET images for the targets at rest. However, the same thresholds significantly over-estimate the target volume if applied to the 3D-PET images of moving targets.

Conclusions: The TBR-threshold-volume curves clearly demonstrate the advantage of gating for detecting the true volume of moving target. Therefore, respiratory-gated PET acquisition should be performed in the presence of relatively large organ movement to accurately determine the gross tumor volume for clinical applications.