AbstractID: 10205 Title: The impact of Source-to-Background Ratio, Tumor Size, Scan Duration, and Smoothing Filter on a Two-Stage PET Tumor Segmentation Method

Purpose: This work systematically evaluates the effect of source-to-background ratio, tumor size, scan duration, and smoothing filter on a novel two-stage PET tumor segmentation method in phantoms. The two-stage method uses an adaptive region-growing algorithm and a dual-front active contour model, resulting in advantages of reproducibility and no need of choosing a threshold. **Method and Materials:** Six spherical tumor phantoms (0.5 – 20 mL) in a warm cylindrical container were scanned for 120 minutes in a PET/CT scanner. The source-to-background (S/B) ratio ranges from 16 to 0.5. For every 2-min scan, three PET images were reconstructed using the iterative Ordered Subset Expectation Maximization (OSEM) algorithm with 5mm-FWHM, 2mm-FWHM post-reconstruction smoothing filters and without the filter, respectively. At S/B ratio 2, images for longer scan durations were also generated. The two-stage method was applied to segment the tumor phantoms with optimized parameters. **Results:** The segmentation accuracy depends mainly on the S/B ratio and tumor size, with a higher accuracy for larger tumor or higher S/B ratio. The 5mm-FWHM filter reduces more noise than the 2mm-FWHM filter and the unsmoothed. This leads to better segmentation for images smoothed with the 5mm-FWHM filter. Lengthening scan duration did not improve the segmentation for tumors ≥ 6 mL, but made the imperceptible 1 mL tumor detectable. The overall differences were not statistically significant between scan durations or between OSEM-2mm and unsmoothed, but were statistically significant between OSEM-5mm and unsmoothed. **Conclusions:** We concluded that a computerized PET tumor segmentation method should incorporate these factors (S/B ratio, tumor size, scan duration, and smoothing filter) if known or estimable. Secondly, it is very important to use the same PET/CT protocol for consistent quantitative evaluation. Finally, longer scan duration improves small tumor detection in PET.