

AbstractID: 7118 Title: Onboard SPECT: Functional-Image-Based Target Localization

Purpose: To investigate clinical feasibility for functional-image-based target localization via onboard single photon emission computed tomography (onboard SPECT). Specifically, to understand lesion visibility and signal-to-noise ratio (SNR) of onboard SPECT imaging with the following simulated variables: lesion size, target-to-background radiotracer uptake, and scan time.

Method and Materials: We simulated onboard SPECT imaging for a patient in treatment position who had received a diagnostic-level dose of hypoxia radiotracer. The planning CT of a typical breast cancer patient with lung mets was segmented into bone, lung, and soft tissue. Lesions were simulated in the right lung that varied in diameter (0.5cm, 1cm, 1.5cm, 2cm, 3cm) and radiotracer uptake (lesion:lung:soft tissue – 6:1:3, 12:1:3, 18:1:3). Radiotracer concentration was $1.4\mu\text{Ci/g}$ in aerobic soft tissue. Attenuation was modeled for 140 keV photons. Projection images were simulated for a gamma camera with parallel collimation, and Poisson noise was added to projections to simulate several scan times: 1min, 2min, 5min, 10min, 20min. Noisy projection images were reconstructed by OSEM (10 subsets, 5 iterations). Post-filtered reconstructed images were then analyzed by plotting image profiles across each lesion and calculating SNR.

Results: One minute scan time provided good visualization of a 2cm lesion with 12:1:3 uptake ratio. When scan time remained constant at 5 minutes, 2cm lesions were visible for each uptake ratio. In another simulation, a 1cm lesion (18:1:3) was clearly visible following 5 minutes of scan time. As expected, SNR generally improved with increased lesion size, scan time, and relative radiotracer uptake.

Conclusion: Scan times on the order of a few minutes yield sufficient information to visualize lesions as small as 1cm in the lung. These results suggest that onboard SPECT may be effective for real-time and functional-image-based target localization.

Conflict of Interest (only if applicable): None.