Prototype imaging protocols for monitoring the efficacy of iodine-131 ablation in differentiated thyroid cancer

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Abstract

Whole-body and single photon emission tomography (SPET) images during sodium iodide-131 ($Na^{131}I$) ablation are useful to confirm the efficacy of ablation using ^{131}I imaging. However, there *have been no attempts* to improve the quality of ^{131}I imaging. We therefore investigated imaging protocols for ^{131}I imaging in differentiated thyroid cancer (DTC). *Phantoms containing ^{131}I were used* to simulate extra-thyroid beds and thyroid beds. To simulate extra-thyroid beds, a phantom containing 0.19, 0.37, 0.74 or 1.85MBq was placed in the acquisition center. To simulate the thyroid beds, four phantoms were applied as normal thyroid tissue, and four phantoms containing 0.19, 0.37, 0.74 and 1.85MBq were arranged around normal thyroid tissue as a cancer. Whole-body imaging was performed at different table speeds, and SPET data acquired with various pixel sizes were reconstructed using a filtered backed projection (FBP) and ordered-subsets expectation maximization with 3-dimensional (OSEM-3D) algorithm. We measu-red full width at half maximum (FWHM) and % coefficient of variation (%CV). Patients were then examined based on the results of phantom studies. *In extra-thyroid beds, slower table speed in whole-body imaging* improved %CV, but had little effect on FWHM. For SPET imaging OSEM-3D produced high-resolution and low-noise images, and FWHM and %CV improved with smaller pixel size, as compared with FBP. In the thyroid beds, only the 1.85MBq phantom could be confirmed on whole-body imaging. Images by SPET had high FWHM and low %CV when the smaller pixel size and OSEM-3D were applied. Accumulation of ≤1.85MBq was detected with a smaller pixel size of ≤4.8mm and OSEM-3D. For $Na^{131}I$ ablation imaging, slower scan speed is suitable for whole-body imaging and smaller pixel size and OSEM-3D is appropriate for SPET imaging. *In conclusion*, we confirmed $Na^{131}I$ accumulation in thyroid beds using slower scan speed (≤15cm/min) on whole-body imaging, and then accurate identification of $Na^{131}I$ accumulation using SPET and CT fusion imaging with smaller pixel size (≤4.8mm) and OSEM-3D.

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