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

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Keywords: Na131I - Ablation - Differentiated thyroid cancer - Whole-body imaging - SPET imaging - Reconstruction algorithm

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Received: 30 July 2013
Accepted revised: 20 August 2013

Abstract
Whole-body and single photon emission tomography (SPET) images during sodium iodide-131 (Na131I) ablation are useful to confirm the efficacy of ablation using 131I imaging. However, there have been no attempts to improve the quality of 131I imaging. We therefore investigated imaging protocols for 131I imaging in differentiated thyroid cancer (DTC). Phantoms containing 131I 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 backprojection (FBP) and ordered-subsets expectation maximization with 3-dimensional (OSEM-3D) algorithm. We measured 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 Na131I 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 Na131I accumulation in thyroid beds using slower scan speed (≤15cm/min) on whole-body imaging, and then accurate identification of Na131I accumulation using SPET and CT fusion imaging with smaller pixel size (≤4.8mm) and OSEM-3D.

Hell J Nucl Med 2013; 16(3): 175-180
Epub ahead of print: 18 October 2013
Published on line: 28 November 2013