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131I ACTIVITY QUANTIFICATION: DETECTION LIMITS AND QUANTIFICATION DIFFICULTIES

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Introduction: I-131 image quantification in nuclear medicine is performed using planar (opposite conjugate view) and/or tomographic methods to obtain data of radiation dose in individuals who received exposure from therapy procedures. Despite the wide number of studies done to validate and to demonstrate the efficiency of both approaches, exist a gap of data for better characterize those limitations regarding object size, background levels and other variables. Rational: The goal of the work was to evaluate detection limits and quantification difficulties involved in each approach. Materials and Methods: I-131 images were performed with a GE Infinia Hawkeye 4, SPECT/CT imaging system fitted with a high energy general purpose (HEGP) collimator. The accuracy of activity estimation was investigated by systematically studying a series of phantoms of varying difficulty in quantification. First, four different sizes spheres were used in a water phantom with varying object concentrations and background levels. Experiment was performed with spheres concentrations of 74 kBq/ml and with no background (clean water filling the rest of the phantom) and then with background concentrations of 0.5% and 1.0% of the sphere concentrations with the four spheres imaged simultaneously. Then the study was repeated with spheres concentrations of 185, 370 and 740 kBq/ml. A torso phantom with defined lung and liver chambers was modified to include the spheres (mimicking tumors), two inside the liver and two outside. In this experiment spheres and background values were the same used before and sphere/liver ratios were 24:1, 16:1 and 12:1. Planar quantification was performed using the geometric mean approach, with carefully attenuation correction using) experimentally determined;?the coefficient of attenuation linear (results were compared with results from standard SPECT images performed using the iterative method of Ordered Subset Expectation Maximization (OSEM). Attenuation map was used to perform attenuation correction. Triple windows energy technique was used to scatter correction in both approaches. Results: Detection limits for spheres experiment was successfully performed using SPECT image, despite of object size, object concentration and background levels used. On planar images, good results were found, except for the smallest sphere when the lowest sphere concentration was used. Torso experiment showed that detection limits on planar images was possible when spheres activity concentration was 185 kBq/ml or more, except for smallest sphere, witch was no visible on these images. SPECT image was superior with torso experiment and all spheres were successfully detected. For activity quantification, both methods yielded good estimates of the known activities in the sphere studies, but when more complex geometries was used with torso experiment, SPECT image showed that can provide consistently better results.