ORIGINAL ARTICLE

Annals of Nuclear Medicine Vol. 19, No. 2, 75–82, 2005

Characterization of ordered-subsets expectation maximization with 3D post-reconstruction Gauss filtering and comparison with filtered backprojection in ^{99m}Tc SPECT

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Purpose: To characterize ordered-subset expectation maximization algorithm with a fixed 3D Gauss post-reconstruction filtering (OSEM) in ^{99m}Tc SPECT as for noise, contrast and spatial resolution with varying number of subset and iteration and to compare OSEM with an optimized set of parameters, with filtered backprojection (FBP) with filter parameters typical of brain and myocardial SPECT, both with and without Chang's method of attenuation correction (AC). ***Methods:*** SPECT images of a Jaszczak phantom with cold rod inserts, hot and cold spheres and capillary line sources were acquired. Different background activity concentrations of the phantom were simulated as well as different lesion-to-background activity ratios. OSEM reconstructions were halted after 5, 10 and 15 iterations using 4, 8 and 16 subsets. ***Results:*** The effect of subset and iteration number over noise is additive: thus, it is possible to define an EM-equivalent iteration number that indicates the product between the subset and the iteration numbers. Noise increases linearly with increasing EM-equivalent iteration number. For each level of nominal contrast, the measured contrast after OSEM shows a little increase with increasing iteration number and saturates after 80 EM-equivalent iterations. The application of AC leads to diminished contrast values both in FBP and OSEM. The contrast of cold lesions after OSEM increases with increasing number of EM-equivalent iteration number: after 80 iterations the contrast values with OSEM overtake the ones obtained with FBP; contrast values diminished as background concentration raised. Resolution values did not change with increasing EM-equivalent iteration number and were higher than those obtained with FBP. ***Conclusion:*** The major findings of the present work are the demonstration of additivity of subset and iteration in OSEM over noise, with the possibility of defining an EM equivalent iteration number, and the superiority of OSEM with respect to FBP in terms of spatial resolution.

Key words: iterative reconstruction, ordered-subsets expectation maximization, filtered backprojection, SPECT