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Attenuation correction using combination of a parallel hole collimator and an uncollimated non-uniform line array source

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Attenuation correction is very important for quantitative SPECT imaging. We designed an uncollimated non-uniform line array source (non-uniform LAS) for attenuation correction based on transmission computed tomography (TCT) using Tc-99m and compared its performance with an uncollimated uniform line array source (uniform LAS) in a thorax phantom study. This non-uniform LAS was attached to one camera head of a dual-head gamma camera, and transmission data were acquired with another camera head with a low-energy, general purpose, parallel-hole collimator at 50 cm-distance apart from the source. The modified TEW using a subtraction factor of 1.0 was employed to correct scattered Tc-99m photons for transmission data. In the phantom experiment, eight TCT data were acquired with the scanning time changed from 2 minutes to 20 minutes for each LAS. The Tc-99m attenuation coefficient (μ) maps with the non-uniform LAS and uniform LAS improved the statistical count variation in the mediastinum filled with water as the scanning time got longer. The Tc-99m μ-map with the non-uniform LAS and 6 minutes of scanning time had equal quality at the center of the thorax phantom to that with the uniform LAS and 16 minutes of scanning time. In conclusion, for the TCT imaging with combination of the parallel hole collimator and uncollimated Tc-99m external source the non-uniform LAS can reduce the Tc-99m radioactivity or the TCT scanning time compared with the uniform LAS.

Key words: attenuation correction, uncollimated non-uniform line array source, parallel hole collimator, myocardial phantom SPECT, Tc-99m