ABSTRACT

Spatial resolution is a critical parameter in the quality control of Single Photon Emission Computed Tomography (SPECT) systems, as it directly affects the system's ability to distinguish two adjacent objects and the quality of the resulting diagnostic images. Acquisition matrix size is one of the factors influencing spatial resolution, as it determines pixel size and the system's capability to sample radioactivity distributions within the image. This study aimed to analyze the effect of matrix size variation on the extrinsic spatial resolution of a GE Discovery NM/CT 670 SPECT system at RSUP Dr. Kariadi Semarang, using a line source consisting of capillary tubes filled with Tc-99m. Measurements were performed using five matrix sizes (64×64, 128×128, 256×256, 512×512, and 1024×1024) on two detectors, with a LEHR collimator at an energy window of 140 keV ±10% and approximately 500,000 counts per acquisition. Spatial resolution was assessed using the Full Width at Half Maximum (FWHM) parameter, analyzed with two software platforms: Xeleris (manufacturer-provided) and Fiji with the IAEA NMQC Toolkit plugin. Results showed that increasing matrix size consistently reduced FWHM values across both detectors and both software platforms, indicating improved spatial resolution. The most significant reduction occurred from the 64×64 to 128×128 matrix, while at 512×512 and 1024×1024, FWHM values approached a plateau in the range of 3.5–4.0 mm on both detectors, corresponding to the system's intrinsic resolution limit. The larger FWHM values at smaller matrices were attributed to the partial volume effect (PVE) and spatial undersampling, while larger matrices exhibited a trade-off between spatial resolution and image noise due to reduced counts per pixel. Although absolute FWHM values differed slightly between the two software platforms, both demonstrated consistent decreasing trends, mutually reinforcing the validity of the findings. Based on these findings, a 256×256 matrix is recommended as the optimal matrix size as it provides the best balance between spatial resolution and image statistical quality, while satisfying the IAEA tolerance limit (FWHM ≤±10% *baseline:* ≤6 mm) with an average FWHM of approximately 4.2–4.96 mm across both detectors.

Keywords: SPECT, spatial resolution, acquisition matrix, FWHM, capillary tube

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