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Comparison of myocardial perfusion imaging between new ultrafast CZT camera and conventional SPECT: anthropomorphic phantom study

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Purpose: The solid-state detector is the novel γ-camera to reduce patient's imaging time and radiation dosage in nuclear cardiology. However, there was a discrepancy of optimal acquisition protocol between Thallium-201 and Tc-99m radionuclide in many literatures. The aim of this study was to compare new ultrafast cadmium-zinc-telluride (CZT) camera with conventional SPECT using anthropomorphic torso phantom to establish the optimal protocol for myocardial perfusion imaging (MPI).

Materials and Methods: Anthropomorphic torso phantom was filled with Thallium-201: 0.72 μCi/mL for cardiac insert; 0.515 μCi/mL for the liver; 0.06 μCi/mL for background as the stress state; and with 0.576μCi/mL for cardiac insert; 0.412 μCi/mL for the liver; 0.048 μCi/mL for background as the rest state. Similarly, phantom was filled with Tc-99m: 1.56 μCi/mL for the cardiac insert; 1.04 μCi/mL for the liver; 0.13 μCi/mL for background as the stress state; and with 3.04 μCi/mL for the cardiac insert, 1.52 μCi/mL for the liver, and 0.34 μCi/mL for background as the rest state. All images were acquired by conventional dual-detector SPECT (e.cam; Siemens) with 15 min. Phantom immediately repeated on an ultrafast CZT camera over a 10-min acquisition time and reconstructed from list-mode raw data to obtain scan durations of 1 min, 2 min, etc., up to a maximum of 10 min. Quantitative analysis was performed on MPI polar maps with conventional SPECT MPI images and 1 to 10 min of CZT detector camera using a 20-segment model for the left ventricle. Intra-class correlation (ICC) was used to compare segmental tracer uptake between conventional SPECT and ultrafast CZT camera. Bland–Altman limits of agreement were calculated per segment for these durations.

Results: Minimal required scan times were 4 min for Thallium-201 both stress and rest (r=0.82; P <0.001; Bland–Altman, -18% to 10.9% for stress; r=0.88; P <0.001; Bland–Altman, -13.8% to 11.1% for rest), and minimal required scan times were 2 min for Tc-99m both stress and rest (r=0.88 ; P <0.001; Bland–Altman, -6.2% to 16.6% for stress; r=0.92 ; P <0.001; Bland–Altman, -10.8% to 10.9% for rest)

Conclusion: Our preliminary results from comparisons of the segmental tracer uptake revealed that the CZT detector camera requires a minimal scan time of 2 min for Tc-99m and 4 min for Thallium-201 to yield excellent image quality in MPI examination.

Keyword: solid-state detector, phantom, Thallium-201, Tc-99m, myocardial perfusion, cadmium-zinc-telluride (CZT)

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