A head-to-head comparison of ^{99m}TC quantitative performance of GE Discovery 870 CZT and Siemens Intevo SPECT-CT

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Objective

Using our methodology developed for a previous comparison of the quantitative performance of several SPECT-CT systems [1], we investigated the contrast recovery for hot and cold objects as well as the absolute quantification potentiality of the CZT-based GE Discovery 870 and the state-of-the art NaI-based Siemens Intevo SPECT-CT.

Method

Phantoms: NEMA NU-2 1994 scatter, 9.4-cm (L) and 20-cm (XL) diameter cylinder. The last one was converted in a contrast phantom (TOM) with two cold and hot rods inserts while leaving a uniform compartment. They were filled with 750-900 (340 for L) MBq of Tc99m and concentration was identical in all radioactive part. Acquisitions: 360° circular orbit, 25-cm radius, 128 projections and 2.4-mm pixels for the Intevo or 120 projections and 2.46-mm pixels for the Discovery. The factory default energy windows were used. Reconstructions: constructor, iterative, CT-based attenuation, resolution recovery, scatter correction (SC) with TEW (Intevo), DEW (Discovery), MLEM equivalent (OSEM iterations x subset number) iterations (ITER) from 40 to 240.

NEMA phantom images were processed as described in NEMA NU-2 1994 to get the residual fraction (RF) in air, water and Teflon. Cylindrical ROIs of about 35% rod height and rod full (ROIF) or half (ROIH) physical diameter were drawn on the CT images together with a large cylindrical ROI in the uniform part of TOM. In all ROIs, mean count per pixel (C) was computed and also standard deviation (SD) in the large ROI. Recovery coefficient (RC) was computed as $C_{rod}/C_{uniform}$ for hot rods and $1- C_{rod}/C_{uniform}$ for cold rods. Coefficient of variation (COV) in the uniform part was $SD/ C_{uniform}$. Conversion factor (CF) were obtained from L and XL phantom using large cylindrical ROIs of various height and diameter and applied to C of uniform part of TOM and radioactive area of NEMA.

Results

RF was very similar for both systems, decreased when ITER increased and was clearly reduced when SC was applied.
RC increased with ITER and rod diameter. Cold RC were moderately higher for the Discovery. Hot RC were slightly superior for the Intevo in ROIF and inferior in ROIH. The hot RC versus rod diameter curves showed outlier points for some diameters leading to a suspicion of Gibbs artefacts. COV increased with ITER more steeply and was systematically higher for the Discovery.

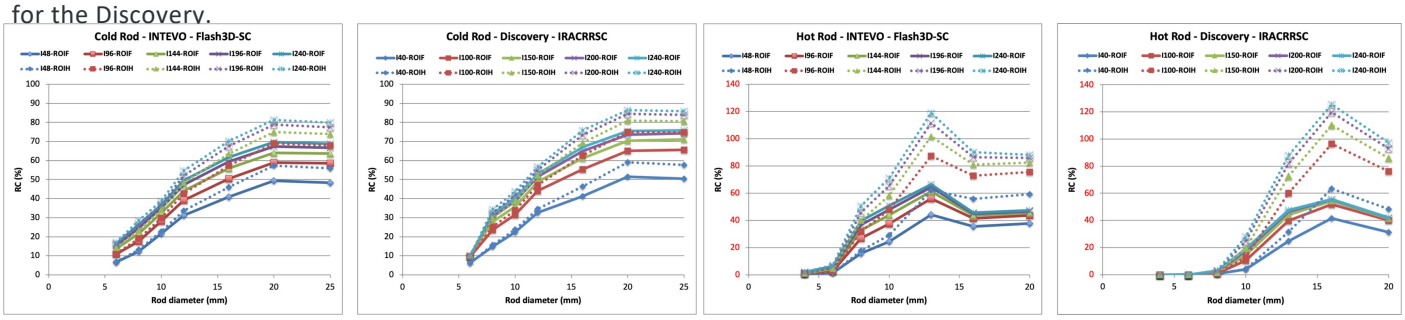

Figure 1. Cold and hot rod recevery coefficient for the Siemens INTEVO and the GE Discovery 870 CZT using constructor iterative reconstruction with attenuation correction, resolution recovery and with or without scatter correction.

The absolute quantification error varied with phantom and region of interest size used for the determination of CF with error in the range ±5% for several combinations of phantom and ROI.

Conclusion

This study did not reveal significant differences for contrast recovery between the two systems. Quantification of large area was possible within 5% but depended on the phantom and ROI used to determine the conversion (calibration) factors.

References

[1] Seret A, Bernard C, Nguyen D. Quantitative capabilities of four state-of-the-art SPECT-CT cameras. EJNMMI Research 2012, 2 :45.

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