EP-0944

Impact of the manufacturer new scatter correction for the market oldest CZT ring SPECT-CT on ^{99m}Tc contrast of small hot and cold objects

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Aim/Introduction: The recently modified scatter correction of the market oldest CZT-based ring SPECT-CT was tested on phantom data from our recent study of this system [1]. Still based for ^{99m}Tc on the dual energy window method, the correction is now (SC25) performed in the iterative loop of the reconstruction whereas it was previously (SC23) a subtraction of the two images reconstructed in the main and secondary windows. ***Materials and Methods:*** Data of NEMA NU2-94 and custom hot (diameter 4-20mm) and cold (diameter 6-25mm) bar contrast phantoms have been reconstructed with (SC) and without (NoSC) scatter correction. Scatter residual fraction (RF) in NEMA phantom, recovery coefficient (RC) in bars and coefficient of variation (COV) in uniform region of contrast phantom were compared to the values obtained with actual (25) and previous (23) versions of the software. Sixteen subsets were used in the OSEM-based reconstruction for different numbers of iterations in order to span a wide range (48-240) of EM updates. The optional resolution recovery for quantification purpose (PSFRq) was also tested. ***Results:*** Results are given for 192 updates where convergence seemed to be reached. RF-SC23 < RF-SC25 < RF-NoSC23 ≈ RF-NoSC25 in water and Teflon inserts of NEMA. For the cold rods: RC-SC23 > RC-SC25 > RC-NoSC25 ≥ RC-NoSC23. For the largest (≥16mm) hot rods, RC-SC25 ≈ RC-NoSC25 > RC-SC23 ≈ RC-NoSC23 and for the thinnest (≤8mm), RC-NoSC25 ≈ RC-NoSC23 ≈ RC-SC23 > RC-SC25=0. SC25 appeared to boost the central part of the two largest hot rods with a RC peaking at 160% for a centered ROI of half the rod physical diameter. In the contrast phantom uniform area, COV-NoSC25 ≈ COV-NoSC23 ≈ 6,5% and COV-SC25 ≈ COV-SC23 ≈ 8,0%. SC25 removed about 11% of counts in this uniform part whereas SC23 removed as much as 32%. With or without SC (23 or 25), PSFRq did almost not change RF and RC of cold or hot rods, neither COV or the percentage of counts removed by SC. ***Conclusion:*** The most striking effect of SC25 was much less count removal in large hot areas. Cold contrasts were slightly reduced whereas the impact on hot contrasts was very size dependent. The thinnest rods were absent from the images and the contrast of the central part of the largest rods was considerably boosted resulting in an increased mean rod contrast. ***References:*** 1. Seret A, Bernard C. EJNMMI Physics 2025; In Press.

EP-0945

Establishing metrologically traceable activity measurements for alpha-emitter astatine-211 to improve the accuracy of equipment routinely used in the clinic

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Aim/Introduction: Targeted alpha therapies (TAT) are currently evaluated in several clinical trials, but the requirement of metrological traceability for the activity measurements of alpha-emitters are typically not met. For ^{211}At ($t_{½}$=7.2h) reference sources are not available. In anticipation of a new clinical trial involving ^{211}At, a measurement using absolute 4pi-alpha liquid scintillation counting was performed [1] to establish metrological traceability to the equipment used in the hospital. The resulting activity measurements were then compared with those derived for a previous clinical trial [2] (without metrological traceability). The aim was to evaluate the impact of metrological traceability when measuring ^{211}At for three radionuclide calibrators and three HPGe detectors. ***Materials and Methods:*** A sample from an aqueous solution of ^{211}At (0.2M NaOH and 20mM NaI) was measured using absolute 4pi-alpha liquid scintillation counting with a combined relative standard measurement uncertainty of 1.1% [1]. Samples from the same solution were then measured in three radionuclide calibrators and the first of three HPGe detectors. The combined standard measurement uncertainty of the radionuclide calibrators was 3.4%-3.8% (excluding the uncertainty that originates from the calibration). Another comparison was performed (using an identical ^{211}At solution) between the first HPGe detector and two HPGe detectors in different labs. Their combined relative standard measurement uncertainties ranged between 5.7%-6.2%. The first two HPGe detectors used decay data from DDEP and the third used data from NuDat3. ***Results:*** For the three radionuclide calibrators, the difference in activity between the setting used for the previous clinical trial and the traceable calibration was 3.9%, 3.9% and -6.9%, respectively. The HPGe detectors differed compared to the traceable calibration 6.6%, -0.1% and 1.7%, respectively. Had the third site also used decay data from DDEP the difference would have been -4.5% (instead of 1.7%). ***Conclusion:*** Before establishing metrological traceability, the radionuclide calibrators underestimated the activity of ^{211}At by up to 7%. HPGe measurements rely on accurate data on the intensity of the 687keV gamma associated with ^{211}At decay. DDEP lists an uncertainty of 5% for this intensity, which is the largest contributor to the uncertainty of the measurements. There is a 6.5% difference in listed gamma emission intensity between DDEP and NuDat3. This highlights the need for better decay data for ^{211}At if HPGe detectors are used for activity measurements. ***References:*** 1.PMID:40184906 2.PMID:19525452.

EP-0946

Novel Scatter and Tail Corrections Improve Low-Activity Lu-177-PSMA Imaging in Digital 3D Ring SPECT/CT

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Aim/Introduction: ^{177}Lu-PSMA has established a foothold in clinical practice recently for treating metastatic castration-resistant prostate cancer. Dosimetry imaging is typically conducted within a few hours to one week post-treatment. Therefore, reliable imaging at low activity levels is critical, especially at late time points. We previously demonstrated that calibration factors (CFs) for both ^{177}Lu photopeaks (113 and 208 keV) in a digital 3D ring-design SPECT/CT system remain stable over a wide range of activity levels. However, at lower activity levels - particularly for the 113 keV peak - CFs begin to drift due to the known tailing effect in CZT detectors. New reconstruction techniques have been introduced to mitigate this drift, including enhanced scatter correction (SC), tail correction (TC), and a combined peak reconstruction option. This study evaluates the impact of these correction methods on CFs at low activity levels in ^{177}Lu imaging. ***Materials and Methods:*** A uniform cylindrical phantom (6480 cm^3) was filled with 3.70 GBq of ^{177}Lu and imaged at multiple time points during decay until near depletion. Activity concentration was determined for each 20 min acquisition. Data were reconstructed for each photopeak