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Impact of reconstruction parameters in Luthetium-177 dosimetry

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Purpose
The aim of this work is to understand and characterise the impact of acquisition and reconstruction parameters in PSMA dosimetry.

Materials and Methods
A standardised phantom with known sphere sizes was used. Lesions and background were filled with 177Lu and the activity was set to mimic the ones found in patients. The phantom was then imaged in a clinical device with varying acquisition time (5, 10, 15 and 20 seconds per projection), matrix size (128x128 or 256x256), reconstruction iterations (5, 10, 15, 20, 25, 30, 35, 40, 45 and 50) and the use of post-processing Gaussian filter (0, 5 or 10mm). All other parameters were kept as per the manufacturer's recommendation (reconstruction method, subsets, angular trajectory, angular steps). The quantification was evaluated based on the sphere recovery coefficient for different sizes. The lung insert and the background were evaluated based on the residual lung error and coefficient of variance, respectively. Lastly, dosimetry based on the single time-point dosimetry implemented clinically was calculated for each generated dataset. Comparisons were made based on their spheres'absorbed doses both with respect to the mean values and dose volume histograms.

Results
The results demonstrated that acquisition statistics and reconstruction parameters significantly affected dosimetry measurements. Higher count statistics led to more accurate and precise dosimetry estimates, while shorter acquisition times led to higher variability in dose estimates. Negligible differences were observed for the evaluated voxel sizes. Standardization of acquisition and reconstruction protocols across different institutions may be necessary to ensure consistent dosimetry estimates and improve patient outcomes.

Conclusion
The findings of this study highlight the importance of SPECT acquisition and reconstruction parameters in PSMA dosimetry and their impact on accuracy and harmonization. The results suggest that acquisition statistics and reconstruction parameters should be carefully considered and optimized to improve the accuracy and consistency of dosimetry measurements.

Primary authors: GRAVINATTI, Milena Cristina; ZANDER, Andrea; GRÜNIG, Hannes; BHURE, Ujwal; PEREZ LAGO, Maria del Sol; STROBEL, Klaus; LIMA, Thiago (Luzerner Kantonsspital)

Presenter: GRAVINATTI, Milena Cristina

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