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MEDIRAD clinical dosimetry study: results and conclusions

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The European project MEDIRAD aims to standardise and optimise practices for the detection and monitoring of radiobiological risks. In Work Package 3, data was collected from 100 patients with thyroid cancer treated with I-131 post-thyroidectomy, enrolled in 4 European clinical departments: Toulouse (IUCT-O), Sutton (RMH), Wurzburg (UKW) and Marburg (UKM). Due to a variety of reasons, each centre designed its own clinical protocol, therefore no acquisition standardisation was possible. In this work, the dosimetry of 71 patients from 3 centres who had at least one CT acquisition is reported.
A software package named OpenDose3D was created as a 3DSlicer module, and adapted to each specific clinical scenario. OpenDose3D converts the CT image into a 3D density map and SPECT images into 3D activity maps, according to the calibration procedure implemented in each centre. Absorbed dose rates were obtained using the Monte Carlo code GATE. Segmentation and registration were implemented using 3DSlicer capabilities. Activity or the absorbed dose rates were obtained at the organ level before time integration.
The validation step was conducted against existing codes for a set of clinical situations, including 131I, 177Lu and 90Y.
For IUCT patients (25 patients, 1 SPECT/CT, 2 FOV), a range of absorbed doses was observed for all segmented organs, with the neck region below 20 Gy (median 4 Gy). For the rest of the organs, the absorbed doses were consistently below 1.6 Gy (median 500 mGy) in the case of urinary bladder wall, below 800 mGy (median 360 mGy) for lungs and salivary glands and below 200 mGy (median 150 mGy) for the other organs.
For RMH patients (25 patients, 1 to 3 timepoints: 1 SPECT/CT + 1 to 2 SPECT, one FOV) a range of absorbed doses was observed for all segmented organs, with the neck region below 24 Gy (median 4 Gy). For the other organs, absorbed doses were consistently below 2 Gy (median 400 mGy) for lungs and salivary glands, and below 400 mGy (median 150 mGy) for the rest of organs.
For UKW patients (21 patients, 1 to 3 timepoints: 1 SPECT/CT + 1 to 2 SPECT, 2 FOV), a range of absorbed doses was observed for all segmented organs with the neck region below 60 Gy (median 14 Gy). For the rest of organs, the absorbed doses were consistently below 1 Gy (median 300 mGy) for salivary glands, and below 400 mGy (median 150 mGy) for the rest of organs.
The dosimetry of three centres was performed using OpenDose3D. The software had to be specifically adapted to each protocol, yet results obtained were quite comparable. In addition, during the validation phase, the observed differences between dosimetry codes applied to the same patients for comparison could be explained. Yet the quality and reliability of dosimetric results largely depends on the quality of the clinical protocol implemented.

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