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Comparison of absorbed dose calculation algorithms in PLANET® Dose and OpenDose3D

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Assessing the accuracy of clinical dosimetry in molecular radiotherapy is a challenging task since the clinical dosimetry workflow (CDW) is composed of different steps contributing to the determination of the absorbed doses.
The starting point of this work was a multi-centric dosimetric study as part of an IAEA-CRP E23005 project, in which a patient who received Lutathera® treatment was analyzed using a standard protocol and PLANET® Dose (DOSIsoft SA) software. The CDW included image registration, segmentation, absorbed dose rates (ADR) computation and their integration over the time to obtain the absorbed doses.
In this work the overall variability of the CDW was compared for one site using another software, OpenDose3D, and the impact of different approaches/methodologies for some specific steps were studied. The main focus was on the absorbed dose computation step, by performing a comparison of the results obtained with PLANET® Dose/OpenDose3D when using local energy deposition (LED) and dose voxels kernel (DVK) convolution, with or without media density correction. Finally, the results were compared to Monte Carlo simulations, assuming both homogeneous/heterogeneous medium.
The preliminary results highlighted the impact of VOI propagation across time, especially when an important gradient of activity is present (mostly for lesions).
By looking only at the absorbed dose computation step, the initial differences on ADR between software were in the range of 4% to 11% (for kidneys and liver) depending on the algorithm used and media density management.
The assessment of the source of variability between absorbed dose computation approaches put in evidence differences in software density correction implementation. By using a similar calibration function the observed differences were reduced. For example, the difference for LED with media density correction decreased from 4% to 1%.
In the final comparison of convolution vs. direct Monte Carlo simulations, a good agreement was obtained (around 5% of difference at maximum).
This work validates the absorbed dose computation approaches implemented in the 2 software in the context of 177Lu-based radiopharmaceutical therapies. It will be further extended to other isotopes (e.g. 131I), and the accuracy of other steps of the CDW will also be evaluated.

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