



Advanced personalised 3D dosimetry based on Monte Carlo simulation for Peptide Receptor Radionuclide Therapy

Salvatore Berenato¹, Elisa Grassi², Federica Fioroni², Domenico Finocchiaro^{2,3}, Mauro Iori², Emiliano Spezi^{1,4}

1. School of Engineering, Cardiff University, Cardiff, UK

2. Medical Physics Unit, Azienda Unità Sanitaria Locale – IRCCS di Reggio Emilia, Italy

3. Department of Physics, University of Bologna, Italy

4. Department of Medical Physics, Velindre Cancer Centre, Cardiff, UK

Contents

- Introduction
- Aims
- Material and methods
- Results
- Conclusions



 Molecular Radionuclide Therapy (MRT) based on the delivery of radiation to malignant tissue through the injection of small radioactive particles into the bloody supply;

 MRT treatments are based on the administration of a fixed measured activity of radioactive material;



Dose calculations are performed using the Medical Internal Radiation Dose (MIRD) schema (MIRD Pamphlet 21, J Nucl Med 2009) that has its limitations;



Metrology for clinical implementation of dosimetry in molecular radiotherapy

http://mrtdosimetry-empir.eu



- Repeated SPECT images can be used to assess the radiopharmaceutical time-activity curves*
 - at the voxel level;
 - using total activities in each structure;

*Dewaraja YK, et al. MIRD Pamphlet No. 23: *Quantitative SPECT for Patient-Specific 3-Dimensional Dosimetry in Internal Radionuclide Therapy*. Journal of Nuclear Medicine. 2012 Aug;53(8):1310-25

*Ljungberg M, et al. *MIRD Pamphlet No. 26: Joint EANM/MIRD Guidelines for Quantitative 177Lu* SPECT Applied for Dosimetry of Radiopharmaceutical Therapy. J Nucl Med. 2016 Jan;57(1):151-62

patient specific characteristics and organs movement lead to uncertainties in the dose delivered; The rigid alignment assumes only roto-translational movements relative to Volume Of Interests (VOIs);



To accurately estimate the dose delivered, non-rigid registration algorithms are preferable.



Assessing the impact of registration methods on absorbed dose calculation in Peptide Receptor Radionuclide Therapy – EANM, 21st-25th October 2017, Vienna, Austria

Project Aims

- To assess the feasibility of incorporating advanced personalized 3D dosimetry into a clinical trial in Peptide Receptor Radionuclide Therapy;
- To develop a workflow in which MRT treatments can be planned and optimised;

Objective

 To compare the dosimetry calculated with a Monte Carlo simulation with the clinical dosimetry calculated with the MIRD scheme;

Material and methods – study workflow





OLINDA/EXM

Raydose software

Material and methods – Raydose



funded by the National Institute for Social Care and Health Research (NISCHR) Project grant no HA09-003

Material and methods – OLINDA/EXM



Stabin, G. M. et al; *OLINDA/EXM: The second-generation Personal Computer Software for Internal Dose Assessment in Nuclear Medicine;* J Nucl Med 2005; 46:1023:1027

Results



Results



Conclusions

- Significant differences between standard accepted clinical method and the workflow based on Raydose;
- Deformable registrations improve the overlap of the sequential scans;
- Clinical trials that use workflows and tools similar to DOTATER overestimate the dose delivered to OARs and lesions;
- 3D image-based dosimetry can contribute to improve treatment

personalised and isotoxic dose escalation;



CANCERRESEARCHWALES YMCHWILCANSERCYMRU





Thank you Any question?

