Cod: PO156

A MICRODOSIMETRIC MODEL OF SOLID TUMOUR MICROVASCULATURE FOR RADIOPHARMACEUTICALS LABELED WITH 223RA, 111IN, 131I AND 177LU

E. Amato[3], S. Leotta[1], A. Italiano[2], L. Auditore[1], R. Gentile[3], N. Quartuccio[3], S. Baldari[3]
[1]*Department of Physics and Earth Sciences, University of Messina, Messina, Italy*
[2]*INFN - National Institute of Nuclear Physics, Section of Catania, Group of Messina, Italy*
[3]*Nuclear Medicine Unit, Department of Biomedical Sciences and of Morphologic and Functional Imaging, University of Messina and University Hospital "G. Martino", Messina, Italy*

BACKGROUND-AIM

Solid tumour radionuclide microdosimetry can be affected by the biodistribution of the radiopharmaceutical off the capillaries of the pathologic vascularization. Aim of the present study was to evaluate the combined effects of radiopharmaceutical diffusion and range of the emitted radiation in a model of tumour microvasculature.

METHODS

We developed a computational model of solid tumour microenvironment around a blood capillary vessel, and we simulated the transport of radiation emitted by by 223Ra, 111In, 131I and 177Lu nuclides using two different Monte Carlo codes: Geant4 and MCNPX.
In particular, we simulated a cylindrical vessel having 10 um of inner radius and 10 um of thickness filled by blood and surrounded by cylindrical layers of soft tissue, 10 um thick each.
For each nuclide, several models of radiopharmaceutical diffusion throughout the capillary vessel were considered: in blood only, representative of radio-embolization procedures, in capillary cells, representative of an anti-angiogenic radiopharmaceutical accumulating in them, and several models of extra-vascular diffusion.

RESULTS

Radial dose profiles around the capillary vessel were obtained and compared between codes and between the physics models available. The results for beta and Auger emitters demonstrate that the photon dose is at least four orders of magnitude lower with respect to the one deposited by electrons. For which concerns 223Ra, the beta emissions of the daughters give a contribution three orders of magnitude lower with respect to the alpha particles, even if with a much longer range.
For each nuclide and for every diffusion model, the Endothelial Cell Mean Dose (ECMD) and the Tumour Edge Mean Dose (TEMD) per unit cumulated activity were computed and represented in tabular form, together with the initial radioactivity (IR) necessary to deposit 100 Gy of dose at the edge of the viable tumour.

CONCLUSION

Such results may help to characterize the dose inhomogeneities in solid tumour therapies with radiopharmaceuticals, taking into accunt the interplay between drug diffusion from vasculature and range of ionizing radiations.