Evaluation of deposited energy by low-range radiations at the cellular level using GEANT4-DNA.

Context:

Targeted Radionuclide Therapy (TRT) is a therapeutic approach to cancer therapy that uses biologic vectors coupled to radioactive emitters. Efficacy assessment requires the evaluation of energy deposits in various cellular compartments (spatio-temporal distribution), in order to maximize the absorbed dose de livered to tumour cells while sparing normal neighbouring cells.

Description of the scientific content of the project:

A previous PhD work carried out in the laboratory considered ovarian cancer cells and low energy electron emitters (Auger electrons). These very short-range particles induce a strong toxic effect at the immediate vicinity of the emission site, which makes them suitable for the therapy of diffuse small cancer targets. Other short-range radiation emitters (Auger and alpha) should be considered, on different cell lines, in order to relate deposited energy to observed biologic effect.

Confocal imaging allows the determination of radioactive sources localisation in various cellular compartments, and to give account of the real cellular and nuclear geometry. Energy deposition maps at the cellular level, for a realistic geometry, will be determined with the radiation transport Monte-Carlo code Geant4-DNA, extension of Geant4 at low energy. Results will be compared to those obtained with other codes such as CPA100, developed within the laboratory to model low-energy particle transport at the sub-cellular scale.

The modelling will consider direct effects induced on isolated cells, the impact of geometry or neighbouring cells. The study of the threshold at which microdosimetry (i.e. the explicit modelling of the stochastic nature of energy deposition) becomes necessary will be performed. This study should lead to revise dosimetric estimates currently based on the MIRD conventional approach.

ACADEMIC COLLABORATION:

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