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Auger electron studies using Monte Carlo simulations of I-123 incorporated into human lymphocytes

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Abstract content
   (Max 300 words)
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The study involves the determination and quantification of radiation damage on a cellular level and the replication of this energy deposition using Monte Carlo simulations. The relatively short half-life of I-123 (13.2 hours) makes it ideal for studies of Auger electrons which induce biological damage similar to that of high linear energy transfer radiations, when permitted to deposit their energy in close proximity to DNA. Due to small cellular dimensions, direct dose measurements are impossible. Estimates may be made from Monte Carlo simulations. In this investigation the thymidine analogue 5-[I-123]-iodo-2-deoxyuridine (123IUdR) was used to incorporate I-123 into the cellular DNA of T-lymphocytes. This allows nanometer range Auger electrons to irradiate the DNA. Radiation induced micronuclei were numerated in binucleated cells using fluorescence microscopy. In order to compare the biological damage caused by the radioactive iodine to other radiation modalities, the incorporated I-123 activities (Bq) need to be converted in a dose absorbed (Gy) value. The energy deposition per decay of I-123 was calculated within a spherical geometry, having the same size and density as a human lymphocyte, using the Geant4 Monte Carlo toolkit. The absorbed energy per disintegration was used to convert the incorporated I-123 activity into absorbed dose values. A linear relationship between micronuclei frequency and I-123 activity could be established. The linear dose-response noted for Auger electrons in the study is indicative of the high-LET nature of these particles. Using the linear-quadratic dose-response curve noted for micronuclei frequencies following exposure to graded doses of Co-60 ɣ-rays obtained from previous experiments, preliminary relative biological efficiency values estimated in this work are in agreement with literature values ranging between 7 and 9 for Chinese hamsters V79 cells exposed to 123IUdR and cell survival compared to that from 250 kVp X-rays.

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Main supervisor (name and email)
and his / her institution

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