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Cancer risk following CT-imaging: A Monte Carlo based study

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Abstract

Computed tomography (CT) has made significant progress over the last decade and allows the discrimination between benign and malignant tumors. Currently, there are approximately 80 millions CT examinations performed in the United States annually. With increasing knowledge about the destructive process of ionizing radiation in living subjects, there is a considerable research interest in the cancer risk from CT scans. The aim of this study is to understand the effects of CT imaging to normal and desiccated cells to predict the risk of DNA damage under low-dose exposure. Mathematical models were investigated to mimics the physical processes during CT scans. Two different cell sizes and three different phantom tissues were considered and implemented in the Monte Carlo (MC) algorithm. Real physical processes such as photoabsorption and Compton scattering were simulated to investigate secondary tracks in anthropomorphic phantoms at two different X-ray energies. We found that the radiosensitivity of cells depends on the target volume, the surrounded tissue and the X-ray energy. The probability of DNA damage caused by CT imaging was $p \approx 0.007$ at 80 kVp and $p \approx 0.005$ at 120 kVp X-rays for muscle tissue. Moreover, backscattered electrons in cortical bone protected deeperlying cells from radiation damage with $p \approx 0.003$ at 80 kVp X-rays. These findings are comparable to the results of cancer risk assessment tools.

Biography

Johann Wanek has studied medical physics and engineering and is currently working on his PhD thesis on the *Direct Action of Ionizing Radiation* at the University College London, UK. He has authored several peer reviewed reports in *Journal of the International Skeletal Society, Radiation and Environmental Biophysics* and has written a book chapter with the title *Fundamentals in Paleoimaging Techniques.* He was also a reviewer at the AUTOMED 2010 (Automation in Medicine), Swiss Federal Institute of Technology Zurich