DOSE3D: an EGS usercode dedicated to internal dosimetry based on combinatorial geometry

J Coulot, M Ricard.

Physics Department, Institut Gustave-Roussy 94805 Villejuif, FRANCE

Introduction

Internal dosimetry requires accurate calculation tools to compute the absorbed dose in tissues from internally deposited radionuclides. Therefore, we have developed the DOSE3D usercode, based on MORSE combinatorial geometry. We present here this usercode, and its last technical evolutions.

Dose calculations at the organ level

DOSE3D was first developed under the DOS release of EGS4-PRESTA based on the UCSAMPCG usercode. It calculates the energy deposited in user-defined volumes using the Medical Internal Radiation Dose formalism. It allows to build relevant models of biological structures, using logical associations of geometric volumes.

We calculated absorbed doses in anthropomorphic phantoms, and results were in good agreement with published values (1). This allows to investigate the influence of individual's morphology on dose distribution (2).

Adaptation to EGSnrc

For beta emitters dosimetry, the mean dose to an organ is not adapted to establish dose-effect relationship, because it does not consider the eventual heterogeneous distribution of radionuclides.

To assess the absorbed dose at both tissular and cellular level we adapted DOSE3D to EGSnrc and its improved electron transport algorithm. Dose point kernel calculations in water were compared to published values, and allows to set the limits of DOSE3D at this scale (3).

Then, we performed dose calculations in thyroid follicular cells using relevant geometric models and demonstrated the influence of iodine concentration and localization on dose distribution in follicular cells (4).

Conclusion

Further developments on DOSE3D include improvements and optimisation of combinatorial geometry with EGSnrc. Therefore, we are writing an accurate HOWNEAR subroutine to reduce calculation times, and improve our dosimetric models.

References

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