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Calculation of doses to pediatric patients from computed tomography examinations

Doses from CT examinations to reference 10- and 15-year-old patients were calculated using Monte-Carlo simulation in voxel phantoms. The exposure of patients of all age groups was simulated by consecutive calculation of exposures with 1 cm collimation each. The resulting table contained 139×H values of doses. 139 corresponds to the organs and tissues segmented in the phantom. H is the height of the patient in cm. The doses were stored in Microsoft Excel file. Further calculations resulted in reducing 139 lines of the file to 28 lines which correspond to the organs and tissues to calculate effective dose. The results show that there is a discrepancy in calculations depending on whether the deck is included in the model. The effect of relative position of phantom and rotation axis was studied. Normalized effective dose at 100 kV (Medium M bowtie filter for Toshiba Aquilion ONE CT scanner) falls from 1.73 mSv/(100 mAs) for 5 year old to 0.699 mSv/(100 mAs) which corresponds to fall by 60%. However, the absolute doses are multiplied by actual time-current product which increases with the thickness of the patient. The following suggestions were made during the calculations. 1) The number of organs and tissues which are used in the phantom could be reduced from 138 at least to 72 by calculating pair organs and extensive organs as single organs. The calculation of effective dose could be performed directly in Monte Carlo software by constructing the appropriate linear combination of organ and tissue doses with tissue weighting coefficients. 2) For the purpose of saving computer time calculation by region could be performed instead of slice-by-slice calculation. Five standard regions should be considered: head, neck, chest, abdomen and pelvis. 3) The accuracy of calculations should be preserved with the highest possible degree.

Section

Applications of nuclear methods in science, technology, medicine and radioecology

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