A NEW CUBIC PHANTOM FOR PET/CT DOSIMETRY: EXPERIMENTAL AND MONTE CARLO CHARACTERIZATION

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In recent years, positron emission tomography (PET) associated with multidetector computed tomography (MDCT) has become a diagnostic technique widely disseminated to evaluate various malignant tumors and other diseases. However, during PET/CT examinations, the doses of ionizing radiation experienced by the internal organs of patients may be substantial. To study the doses involved in PET/CT procedures, a new cubic phantom of overlapping acrylic plates was developed and characterized, with overall dimensions of 12x13x14 cm^3. The outer plates had thickness of 8 mm and were prepared to accommodate the OSLDs on their inner surfaces. The acrylic inside the cube was removed to accommodate another cube, made of PLA, for the positioning of the 18F-FDG solution. This latter cube was a container with a volumetric capacity of 20 ml and, once filled, it represented a region of high FDG absorption, i.e., similar to an internal tumor. This container was not positioned in the center of the phantom in order to provide different thicknesses of acrylic between the source and the detectors. There are also small holes near the faces for the insertion of optically stimulated luminescence dosimeters (OSLD). The holes for OSLD are positioned at different distances from the 18F-FDG deposit. The experimental results were obtained in two PET/CT devices operating with different parameters. Differences in the absorbed doses were observed in OSLD measurements due to the non-orthogonal positioning of the detectors inside the phantom. We also evaluated this phantom using Monte Carlo simulations, with the MCNPX code. The phantom and the geometrical characteristics of the equipments were carefully modeled in the MCNPX code, in order to develop a new methodology form comparison of experimental and simulated results, as well as to allow the characterization of PET/CT equipments in Monte Carlo simulations. This is in accordance with the distribution of photons simulated by the Monte Carlo method. The Monte Carlo method proved useful in aiding the interpretation of the results obtained with in simulating accurately the absorbed doses obtained in the OSLD and phantom simulations. All results showed good agreement, proving that this new phantom may be applied for these experiments.