Tissue Equivalent Materials Determination of a Physical Phantom Used for CT Examinations Dosimetry

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Abstract: Physical anthropomorphic phantoms have an important role in radiation dosimetry studies and quality assurance of medical imaging. Therefore, the phantoms' equivalent materials should have the same physical properties as human's tissues. Hitherto, different tissue equivalent materials loaded in different physical phantoms for internal and external dosimetry purposes. Although wide range of equivalent materials has been introduced, the purpose of our study was finding the best tissue equivalent materials in x-ray radiations from CT examinations.

The principal characteristic which should be considered for selecting the best equivalent material in photon studies is density and mass attenuation coefficient. Achieving this goal, in the first phase, the gamma's mass attenuation coefficients for different materials such as K₂HPO₄, B-100, A-150, Urethane, Polyurethane, SL5510, Tissue-equivalent gas (methane based or propane based), the composition recommended by White and even water was calculated. The results showed that using Polyurethane as soft tissue or White compound provides better agreements.

Then, absorbed doses in TLD which were set in 8 organs were calculated by MCNPX simulation for ORNL hermaphrodite phantom for three different tube voltages (80, 100 and 120 kVp). This step was repeated by replacing the original tissue of ORNL phantom by best equivalent materials determined from the previous phase. Finally, it was observed that differences between amounts of dose in TLDs placed in original tissues and equivalent tissues of White compound was less than that of Polyurethane.

Key Words: Physical phantom, CT dosimetry, TLD, X-ray spectrum.