Determination of the uncertainty in lung dose in an external photon exposure

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Abstract: In the past of 100 years, diagnostic imaging and radiation therapy have gradually become crucial instruments for all branches of medicine. Using radiological techniques increase concern about secondary cancers. To estimate the radiation risk, organ absorbed and effective dose are calculared using computational model of human body (phantom) in different internal and external radiation fields. Obtained results based on the reference adult male and female were classified as a dose library data. However, this standard data may not be valid for various patients with different sizes, masses, and anatomies. In the case of chest imaging that widely used for diagnosis of pulmonary embolism or lung cancer, the lung absorbed dose may be influenced by the mass and shape of lungs, ribs and the exterior shape of the trunk. Otherwise construction of specific patient phantom is very difficult and time consuming. Thus determining the standard deviation (SD) of the organ absorbed dose from library data in different internal or external radiation field would be very useful. In the present paper, authors try to quantify energy-dependent SD of lung absorbed dose in an external photon exposure using Adult Male (AM) phantom, which is introduced as a reference phantom by International Commission of Radiation Protection. For this purpose, the lung mass of AM was changed based on a Gaussian distribution of lung mass twenty times. After modifying the mass, new phantoms were constructed by replacing new lungs in AM phantom and organ absorbed doses were calculated by MCNPX 2.6.0 code for Anterior-Posterior irradiation geometry. Finally, energy-dependent mean values and SDs of the lung absorbed dose distribution was obtained. Results indicated that dose distributions have slight deviations from the mean value for high energy photons.

Key Words: Statistical phantom, Organ absorbed dose, MCNPX 2.6.0