Study of Radiation Dose in Conventional Pediatric Radiological Examinations

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Introduction

The aim of this study was to evaluate the radiation dose received by pediatric patients in conventional radiology examinations in a large pediatric hospital in Brazil. Kerma-Area product (KAP) and incident air kerma (Ka,i) values were measured from examinations of the chest (Antero-Posterior and Lateral), skull (Antero-Posterior, Lateral and Towne), abdomen (Antero-Posterior and Standing Antero-Posterior), pelvis (Antero-Posterior and Frog) and sinuses (Antero-Posterior, Lateral and Waters).

Methods

Two methods were used to estimate the dose for each exam: the incident air kerma calculation, based on the X-ray tube output values and technical parameters; and also, a dose-area product meter (μGy*m²) manufacturer-coupled to the equipment. Anthropometric data of the patients (weight, age, height and thickness), radiographic technique data (voltage, electric current, exposure time and dose-area product) and examination classification data (clinical indication) were collected. The research involved 632 pediatric patients between 0 and 17 years old and 1400 projections. The patients were classified into 4 age groups, weight and body mass index, as children can present great variations in development and only one classification does not reflect the reality of the population.

Results

The results obtained were compared with other studies and with international dose reference levels. Data analysis showed a heterogeneous population within the same age group, resulting in the use of different radiographic techniques in the exams. The projections showed values of incident air kerma and kerma-area product higher than expected for weight and age. In the routine of the service, the anti-scatter grid was used in all examinations.

Conclusions

Considering that each study uses different technologies, it is important to perform an optimization analysis in order to assess whether the values reflect the radiation levels of the imaging center.

Attenuation images of Optical CT using Fricke xylenol solution for dose mapping in radiotherapy

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Introduction

Fricke gel solution is interesting for dosimetry due to its density close to water. Ionizing radiation produces chemical reactions in the Fricke solution that generates ferric ions proportionally to the absorbed dose. Combined with a binder and edible gel, Fricke Xylenol Gel (FXG) allows 3D dosimetry. Optical computed tomography is used to reconstruct three-dimensional images of the solution, correlating attenuation variations with the deposited dose.

Methods

A flask with FXG solution 7 cm height and 5 cm in diameter was positioned inside a water phantom with dimensions 30 cm x 30 cm x 20 cm. Irradiation with a dose of 5 Gy was delivered using a cobalt-60 gamma source from the Theratron 780c system with a 10 cm x 10 cm field size and source-surface distance of 100 cm. Lead filters 3 mm and 5 mm thick and 14 mm diameter were fixed in the flask, positioned in front of the beam and irradiated with 5 Gy also.

Results

The FXG solution was evaluated using the Vista 16 equipment (ModusQA) before and after irradiation. The results of these evaluations are reconstructed images from the obtained projections. From these images it is possible to extract the attenuation values of each region of the irradiated FXG solution. Figure 1 shows (a) the irradiated region without a lead filter, (b) the region with a 3 mm lead filter, and (c) the region with a 5 mm lead filter.

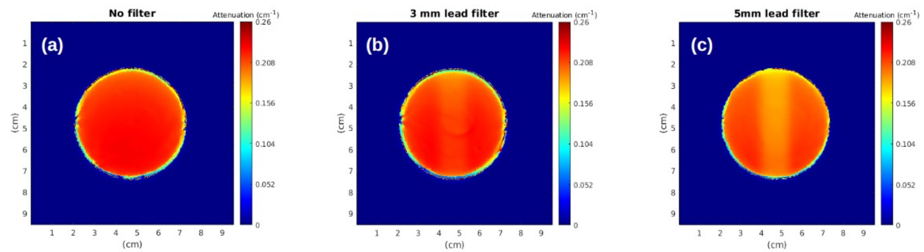

Figure 1: Reconstructed images of the FXG solution regions and a color bar correlated to the attenuation value. (a) Irradiated region of the FXG solution without a filter, (b) irradiated region with a 3 mm lead filter, (c) irradiated region with a 5 mm lead filter.

Conclusions

The optical computed tomography technique used in this study presents the potential to be employed in future works to evaluate the doses delivered in radiotherapy procedures. The relationship between dose and attenuation can be used to predict the dose distribution in irradiated tissues allowing a more precise assessment of treatment efficacy and minimizing the risk of collateral damage to the patient.