Establishment of a local Diagnostic Reference level for Paediatrics Computed Tomography in Saudi Arabia

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Introduction

Due to the increased sensitivity of pediatrics to ionizing radiation and the radiation dose received during computed tomography (CT) examinations compared to other x-ray imaging techniques, it is necessary to monitor the pediatrics' CT doses to investigate and establish remedies to reduce the possibility of errors or negligence, that may lead to radiation doses unnecessary received by patients. This study aimed to estimate pediatric doses during CT procedures as a basis and part of the optimization process for pediatric computed tomography procedures.

Methods

The study was conducted using CT machines from various vendors. The study was carried out at radiology department at King Abdulaziz university hospital Jeddah, Saudi Arabia. Pediatric patients were defined as aging from 0-15 years. Each group divided into three sub-groups, group 1 (0-5 years), group 2 (6-10 years), and group 3 (11-15) years. Pediatric patient data related to radiation doses, including volume CTDI (CTDIvol (mGy)), dose length product DLP(mGy.cm).

Results

A total of 265 patients were divided into three groups according to their age. The mean and range for pediatric CTDIvol (mGy) and DLP (mGy.cm) were 374(10- 2373) ,334 (31-1739) ,508 (23-2393), and the CTDIvol (mGy) were 19.9 (0.4–153), 15.6 (0.36–83), and 19.9(1.2-101.1) for group 1,2 and 3,respectively. The estimated diagnostic reference level(DRL) in terms of CTDIvol (mGy) and DLP (mGy.cm) were 15.3 & 253, 22 & 436 and 14 & 600 for group 1,2 and 3, in that order.

Conclusions

Wide variation of patients doses were noticed up to 20 folds on average for the same clinical indication. The radiation doses are within the published diagnostic reference levels (DRL). Still, continuous efforts are required to optimize the imaging protocol based on clinical indication, patient size, and staff training for better dose reduction outcomes

Computational evaluation of the bucky components influence on the estimation of normalized glandular dose in digital mammography

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Introduction

The mean glandular dose (MGD) is the most suitable dosimetric quantity used in mammography to describe the absorbed dose by the breast, which cannot be acquired directly. Studies have provided conversion factors widely implemented in international dosimetry protocols to estimate MGD, such as normalized glandular dose (DgN). Over time, the DgN estimation was refined by considering geometric models that approach a real clinical environment, such as new anode/filter combinations, compression plate and breast models. However, there is no detailed study on how the bucky (support plate, anti-scatter grid and detector) can affect the DgN estimation.

Methods

A modified PENELOPE Monte Carlo code was used to DgN estimation. The irradiation geometric model was built as a complete digital mammography system, considering different typical bucky models present in commercial mammography units. The simulations were carried for mono and polyenergetic beams for different imaging geometries.

Results

Studies with monoenergetic beams showed that the bucky presence affected DgN mainly for higher beam energies and thinner breasts. The support plate was the bucky component that most affected the DgN, followed by the anti-scatter grid and finally, the image detector. Studies with polyenergetic conventional (low-energy) spectra showed that the bucky exerted minimal influence over the DgN values (<1.1%). For high-energy spectra, mainly employed in modalities such as contrast enhanced digital mammography, the DgN values were more affected by the bucky, increasing in 4.8% the DgN values for a 2 cm thick breast and a W/Cu 50 kV spectrum.

Conclusions

The bucky inclusion in computer simulations is highly recommended mainly for thinner breasts and high-energy spectra. To simplify the simulations, we suggested that a thick homogeneous carbon fiber block support, with thickness between 3 and 4 mm, placed under the breast, can be used as a substitute for a complete bucky model.