DOSE CONVERSION COEFFICIENTS FOR PEDIATRIC CT PROCEDURES BASED ON SPECIFIC SIZES: OPTIMIZING RADIATION PROTECTION OF SAUDI CHILDREN

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OBJECTIVES
The aim of this study is to estimate the effective dose of pediatric patients undergoing chest and abdomen CT procedures for different patient sizes. It is also aimed to determine the normalized dose conversion coefficients for Saudi Children of age group 0, 1 and 5 years old.

METHODS
Records of the weight and height of 321 pediatric patients who had chest and abdomen CT examinations were retrieved. The patients were grouped into age groups of 0 (neonates 1 day to 5 months) 1 (6 months to less 2 years) and 5 (2 to 5 years). The equivalent cylindrical diameter (ECD) was determined to estimate the patient diameter. The calculation of ECD used the relationship ECD = 2\[(w/ \pi*h)]^{1/3} \text{ where ECD is the equivalent cylindrical diameter in cm, w is the weight in grams and h is the height in cm}\]. The obtained ECD was compared with the standard pediatric diameters of the National Radiological Protection Board (NRPB). In the study, a GE 16 slice CT imaging system was used. The data on peak kilovoltage (kVp), tube current (mA), rotation time, slice thickness, pitch, total scan time and CTDI vol values were retrieved. In cases where the CTDIvol values were recorded, the CTDI vol values were calculated. The CTDI values considered in this study were the values displayed on the monitor.

The effective doses due to CT were estimated using the CT Expo v1.7 dose calculator program. The normalized dose conversion coefficient values in mSv/mGy for chest and abdomen procedures were determined by dividing the effective dose as determined by the CTDIvol for different ECD. A graph of the dose conversion coefficient with ECD was generated and a curve fitting equation was generated.

RESULTS AND DISCUSSION

Figure 1 shows the calculated equivalent cylindrical diameter for age groups 0, 1 and 5 and the NRPB standard diameter for the same age group. The estimated ECD from the obtained patient data for the age groups 0, 1 and 5 (Figure 1) is in good agreement with the NRPB standard sizes. Correction factors using standard phantoms can therefore be introduced to different sizes of children.

The exposure parameters for chest and abdomen procedures are shown in Table 2. There is a wide variation in the tube current (mA) used for patients in the 3 age groups for both chest and abdomen and the kVp used for chest is the same as that for abdomen. The rotation time for chest was either 0.5 or 1 sec only while for abdomen, it varied from 1.2 to a maximum of 2.5 sec. The normalized dose conversion coefficient values were higher than the NRPB values for the same age group. Hence dose to patients should be optimized and dose reduction techniques should be introduced to different sizes of children.

The peak kilovoltage (kVp), average mA and rotation time (sec) with the equivalent cylindrical diameter for the same age group. Figure 1 shows the calculated equivalent cylindrical diameter used in CTDI vol values were calculated. The CTDI values for both chest and abdomen procedures performed on pediatric patients in age groups 0, 1 and 5 years old. There are wide variations in the exposure factors for chest CT for the 3 age groups and therefore investigation should be made on the techniques used by different technologists. The wide variation in dose in CTDI vol can be attributed to the difference in clinical practice and non-harmonization of protocols. Protocols should be standardized and technologists should be informed on any change in the protocols. Age groups 0 and 1 obtained almost the same effective dose as that of age group 5 for chest procedure. There is a need to lower the tube current for chest CT of neonates. Lowering the tube current to 25 - 40 for chest procedure can make further reduction without significant difference in the image quality. There is a need to provide training to technologists and radiologists on the nature and optimization of radiation doses. There is a need to lower the tube current and radiologists should be informed of any change in the protocols. The exposure factors for chest CT for neonates and infants should be reviewed for dose reduction. There is a need to provide data on phantom dose measurements and compare it with the doses obtained with the current protocols for dose reduction and image quality.

REFERENCES:
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FIGURE 1. Graph of the conversion coefficient against the equivalent cylindrical diameter (ECD) for chest procedure showing the curve fitting second degree polynomial equation.

FIGURE 2. Graph of the calculated mean effective (mSv) for patients in age groups 0, 1 and 5.

FIGURE 3. Graph of the conversion coefficient for abdomen procedure giving values in the range of 0.45 to 0.47 mSv/mGy with a mean value of 0.46 mSv/mGy for the 3 age groups.

In the calculation of the conversion coefficients, the conversion coefficient for abdomen procedure gave values in the range of 0.45 to 0.47 mSv/mGy with a mean value of 0.46 mSv/mGy for the 3 age groups.

The conversion factor for chest procedure varied from 1.2 to 2.5 for the 3 age groups (2.3 mSv) as shown in Figure 2. The mean effective doses for chest are the same for the 3 age groups (2.3 mSv) as shown in Figure 2. The mean effective doses for chest and abdomen procedures performed on pediatric patients in age groups 0, 1 and 5 years old. There are wide variations in the exposure factors for chest CT for the 3 age groups and therefore investigation should be made on the techniques used by different technologists. The wide variation in dose in CTDI vol can be attributed to the difference in clinical practice and non-harmonization of protocols. Protocols should be standardized and technologists should be informed of any change in the protocols. Age groups 0 and 1 obtained almost the same effective dose as that of age group 5 for chest procedure. There is a need to lower the tube current for chest CT of neonates. Lowering the tube current to 25 - 40 for chest procedure can make further reduction without significant difference in the image quality. There is a need to provide training to technologists and radiologists on the nature and optimization of radiation doses. There is a need to lower the tube current and radiologists should be informed of any change in the protocols. The exposure factors for chest CT for neonates and infants should be reviewed for dose reduction. There is a need to provide data on phantom dose measurements and compare it with the doses obtained with the current protocols for dose reduction and image quality.