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Evaluation of entrance surface air kerma in pediatric chest radiography

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HIGHLIGHTS

- The entrance surface air kerma of chest X-ray examinations in pediatric patients was estimated.
- The data were analyzed for patients aged up to 15 y, stratified by age.
- The doses of LAT examinations were 40% higher than of AP/PA because of kV used.
- An increase in kV with a decrease in mAs leads to significant dose reduction.

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ABSTRACT

The objective of this study was to evaluate the entrance surface air kerma in pediatric chest radiography. An evaluation of 301 radiographical examinations in anterior–posterior (AP) and posterior–anterior (PA) (166 examinations) and lateral (LAT) (135 examinations) projections was performed. The analyses were performed on patients grouped by age; the groups included ages 0–1 y, 1–5 y, 5–10 y, and 10–15 y. The entrance surface air kerma was determined with DoseCal software (Radiological Protection Center of Saint George's Hospital, London) and thermoluminescent dosimeters. Two different exposure techniques were compared. The doses received by patients who had undergone LAT examinations were 40% higher, on average, those in AP/PA examinations because of the difference in tube voltage. A large high-dose "tail" was observed for children up to 5 y old. An increase in tube potential and corresponding decrease in current lead to a significant dose reduction. The difference between the average dose values for different age ranges was not practically observed, implying that the exposure techniques are still not optimal. Exposure doses received using the higher tube voltage and lower current-time product correspond to the international diagnostic reference levels.

1. Introduction

There is growing concern about the amount of absorbed dose in patients undergoing radiographic examinations (Azevedo et al., 2006; Lacerda et al., 2008; Suliman and Elawed, 2013). This concern is greater in children, who have a longer life expectancy than adults and are more sensitive to ionizing radiation (UNSCEAR, 2013). X-ray equipment is not designed solely for pediatrics, and consequently, the equipment is not optimized for this purpose.

Significant progress in the improvement in radiographic equipment has been achieved in the last decades (high frequency X-ray generators, film-screen systems with high relative speeds, computed and digital radiography, etc.) resulting in reduction in the patient dose. However, one of the most significant contributions to decrease the mean radiation dose was the implementation of quality assurance programs to control correct usage of the radiographic equipment (Huda et al., 2008).

The introduction of the concept of diagnostic reference level (DRL) (ICRP, 2013) has established the benchmarks for achievable doses. However the DRLs should not be considered as technical limits. They are established by surveying an appropriate quantity in a range of institutions and are subject to change with the improvement of radiographic equipment and the technique used. That is why the achievements in dose reduction are of constant

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interest especially in the developing countries that were not covered in previous surveys.

Chest radiography is the most frequent pediatric X-ray examination. The purpose of the present study was to estimate the entrance surface air kerma (ESAK) of anterior–posterior (AP), posterior–anterior (PA) and lateral (LAT) projection chest X-ray examinations in pediatric patients. The data were analyzed for patients aged up to 15 y, stratified by age.

Table 1
Number of examinations by projection type in each age group.

	0–1 y	1–5 y	5–10 y	10–15 y	Total
AP/PA	48	58	34	26	166
LAT	34	47	29	25	135

2. Materials and methods

The investigation was performed at the Clinical Hospital of the Federal University of Paraná, Brazil. Before the beginning the research project was submitted to the Ethical Committee of the Hospital that is linked to the Brazilian Federal Government. All patient's parents received instructions and gave the approval about the survey.

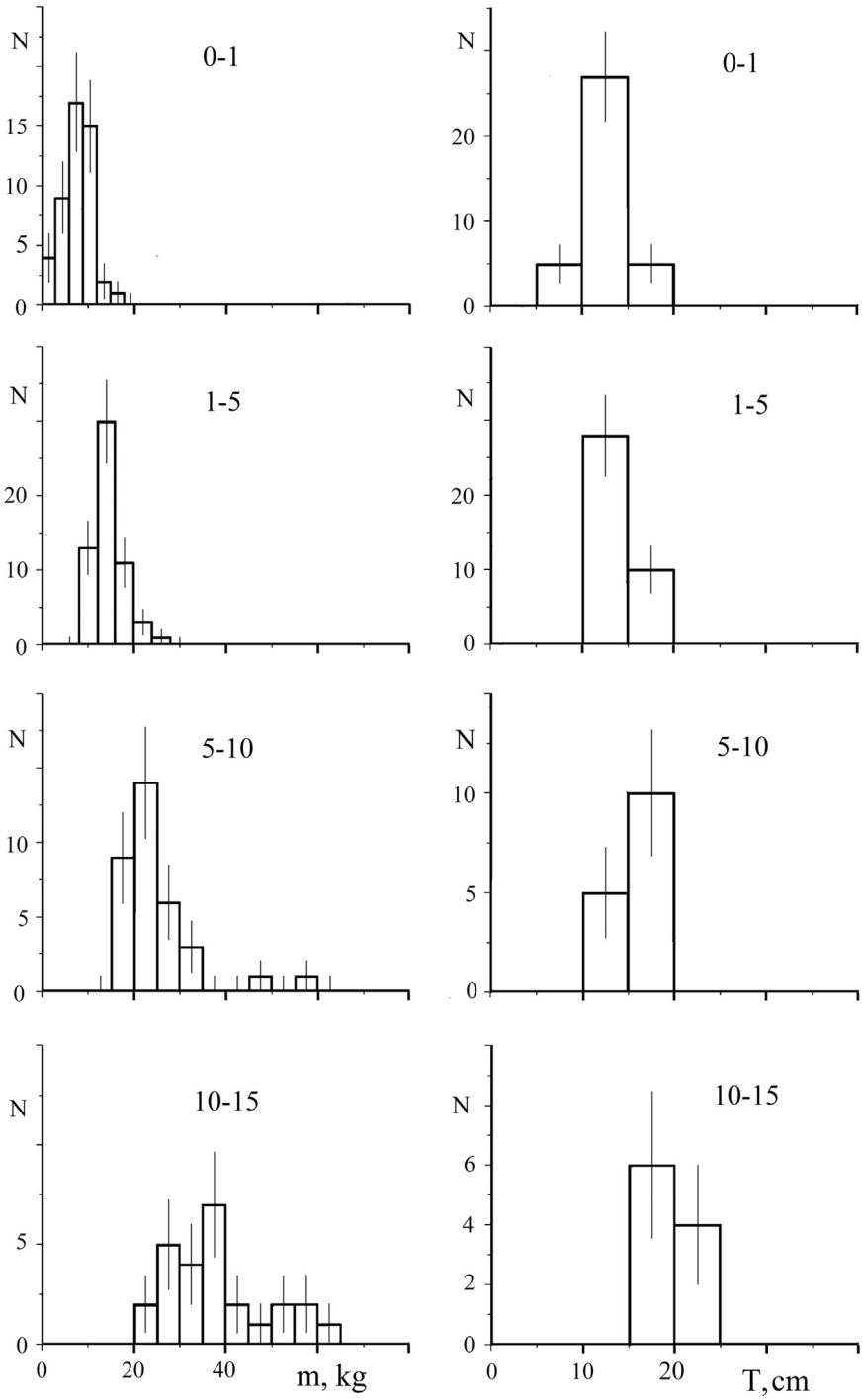

Fig. 1. Weight and thickness of patients who underwent AP/PA examinations.