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Measurement of Entrance Surface Dose (ESD) In Pediatric Patients Undergoing Chest X-Ray at Federal Teaching Hospital Gombe, North-Eastern Nigeria

Kurama M B[1], Gurama A D[2], Goni M M[1], Shettima A B [1], Gunda N M[1], Njiti M M[1]and Danyelwa I Y[2]

[1] *(Department of Medical Radiography, University of Maiduguri, Nigeria)*
[2] *(Department of Medical Radiography, Usmanu Danfodio University, Nigeria)*
Corresponding Author: Kurama M B

Abstract: *to measure the entrance surface dose (esd) in paediatric patients undergoing chest x-ray examination at federal teaching hospital, gombe. Tld chips were used to measure the entrance surface doses (esd) in 30 patients that came for chest x-ray examination. Their ages range from 1years to 13years. The following technical factors were recorded: kilovoltage, tube current, and focus-to-surface distance. Also the weight, height, and thickness of the patients were recorded.the maximum and minimum esd measured for the chest x-ray examination were 0.530mgy and 0.165mgy respectively. The average mean esd measured for the chest x-ray examination was 0.30mgy.the study has established esd for paediatric patient at federal teaching hospital gombe. The result is comparably lower than the results in similar study conducted in the south western nigeria, but relatively higher than the values obtained in south africa and ireland.*

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I. Introduction

Scientific research is ever developing day after day particularly in the area of patient Radiation Dose measurement in radiology as operational diagnostic tools as well as therapeutic (Mesfin et al., 2017*)*. Clinical procedures in radiography utilize radiation exposures given at different rates. Effects of ionizing radiation on human tissue necessitated the development of strategies for radiation protection in all fields of human endeavor. The International Commission for Radiological Protection (ICRP) recommends that the medical activities involving ionizing radiation should fulfill the two basic principles of justification and optimization (Osman et al,. 2014). One of the requirements of the optimization process is regular periodic monitoring of the performance of radiological equipment and assessment of techniques employed during their usage. The focus of such monitoring serves to maintain standards, image quality and very importantly, patient doses. It seeks to establish values of measured quantities above which corrective action needs to be taken (*IAEA, 1996*).

Radiation protection of the patient is so highly priced that several regulatory bodies have carried out studies leading to establishment of standards and regulations to guide its practice.Entrance surface exposures (ESE) have been used to report patient doses, and this has been studied for both adult and pediatric patients in many parts of the world (Azevedo *et al*., 2006).

Radiation protection in pediatric radiology deserves a special attention as children are known to be more sensitive to the ionizing radiation than adults. United Nation Scientific Committee on Effects of Atomic Radiation (UNSCEAR) have reported that children exposed to radiation at an age below 5 years are 2 to 3 more sensitive when compared with their adult counterparts. It is therefore important that radiation dose to children arising from diagnostic medical exposure is minimized to the acceptable level (Gerhard et al,. 2011).

This study is aimed at measuring radiation dose for pediatric patients during routine chest x-ray examination.

II. Methodology

A cross sectional prospective study of pediatric patient aged 1 -13 years was used in this study. Out of all pediatric patients who were sent to the radiology department for a chest x-ray examination between July and December, 2011, a total of thirty (30) pediatric patients were selected for the study.Entrance surface dose (ESD) measurements were made by attaching a sachet containing 2 thermoluminescent (TLD) chips to the changing gown of the selected participants on the central axis of the X-ray beam.The lithium fluoride chips used were TL 100, Harshaw type, these were annealed by heating them at 400°C for 1 hour and then at 80°C for 18 hours. The annealed TLDs were read using a TLD reader (Solaro 680, Vinten) at the centre for energy research and

training, Ahmadu Bello University (ABU), Zaria Nigeria. The TLD reader was calibrated by the National Radiation Laboratory, Denmark and found to be performing within the recommended levels of precision and accuracy.

Chest radiography projections were taken using a 3-phase, 6 pulse GE x-ray machine with model number: GE 5189248. It has a maximum tube voltage and current of 150 kVp and 630 mA respectively, with an inherent filtration of 1.5 mm Al at the tube housing and added filtration of 1.00 mm Al (total filtration of 2.5 mm Al). All the chest radiographs were taken within the ranges of 100 to 150 cm focus to film distance (FFD).

The BSF was calculated to be 0.65 as calculated by physicist at the centre for energy research and training, ABU Zaria, and was multiplied with average readings of the TLD chips in each sachet attached to the participating patients to obtain the resultant ESD. Using the formula below:

$$ESD - ID * BSF$$

Where;
ESD = Entrance surface dose
ID = Incident absorbed dose
BSF = Backscatter factor

III. Results

A total of 30 patients between the ages of 1 to13 years were included in the study. The study group consists of 13 (43.3%) males and 17(56.7%) females. The entrance surface dose (ESD), patient age, sex, weight ,height, thickness, tube current, tube voltage, FFD and projection were evaluated. 0.530 mGy was found to be the maximum value among the ESD obtained. This corresponds to patient with the serial number 01, which was irradiated with 66 kVp, 200 mA and 0.03s as exposure factors. While the minimum dose obtained was 0.165mGy, which corresponds to the patient with serial number 26 exposed with 55 kVp 200 mA and 0.05s.

Fig 4.1 shows the comparison of mean averaged of the study with the previous studies. Average Mean ESD of 0.30mGy was obtained and compared with 0.05mGy in Ireland by Mooney & Thomas (1998), 0.45mGy in Nigeria by Ogundare *et al*., 2004, and 0.075mGy in South Africa.

Table 4.1: Shows age distribution of the research participants

Age Group (years)	Frequency (%)	Mean± SD
1-5	12(40%)	3.1±1.4
6-10	8(26.7%)	8.3±1.3
11-15	10(33.3%)	12.2±0.8
Total	30(100%)	

Table 4.2: Shows gender distribution of research participants

Sex	Frequency	Percentage
Male	13	43.3%
Female	17	56.7%
Total	30	100%

Table 4.3: Descriptive statistics of the variable

PARAMETERS	MEAN ± SD
Age	7.5 ± 4.1
Kilovoltage(kVp)	65.3±6.7
Tube current(mAs)	7.8±2.8
Weight(kg)	22.0±11.2
Height(m)	0.89±0.43
ESD(mGy)	0.3± 0.1

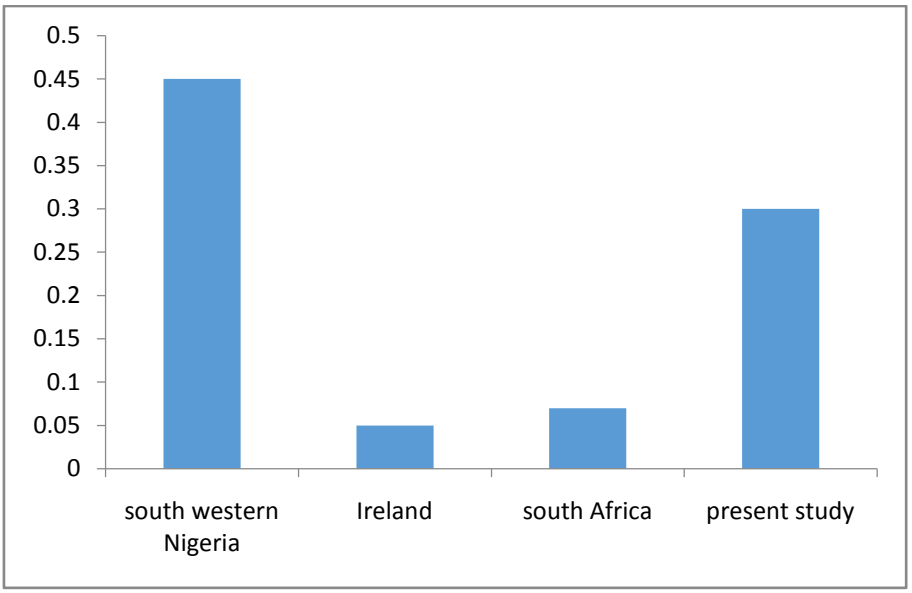

Fig 4.1: Comparison of average means ESD (mGy) of present study with pervious studies

IV. Discussion

Children are more radiosensitive than adults (Azevedo *et al.*, 2006). They also have a longer life expectancy over which they may develop cancer from exposures to ionizing radiation (UNSCEAR, 2000). The pediatric radiology and medical community has long had an awareness of this issue and has developed radiation protection policies and practices that reflect this. With the increased use of ionizing radiation, there is increasing attention to this issue by the entire medical and radiology communities (Derek *et al.*, 1999).

In this study, it was indicated that the average mean ESD measured was 0.30mGy.This is contrary with a studies conducted by Ogundare *et al*, (2004), Swart (2005), and Mooney & Thomas (1998) founded that the average mean entrance surface dose(ESD) for paediatric patients were 0.45mGy, 0.07mGy and 0.05mGy respectively as shown in fig 4.1 above. Similarly, the mean ESD computed from this study was almost 60% higher than those obtained from other studies conducted in South Africa and Ireland, 40% less than a study conducted by Ogudare *et al.*, (2004) in Nigeria. The ESD obtained in this study and the other studies conducted in Nigeria is above the diagnostic reference level. This difference might be due to the unavailablility of special x-ray equipment for pediatrics in Nigeria, absence of quality assurance programme on the x-ray equipment and lack of proper trained personnel for pediatric examinations.

Finally, it was indicated that the age group 1-5years has the highest number of participants of 12(40%) with an average mean of (3.1±1.3), and the age group 6-10 years has the lowest number of participants of 8.0(26.7%) with an average mean of (8.7±1.3). This is in line with a study conducted by Ogundare *et al*, (2004).

V. Conclusion

The study has established ESD for paediatric patients at Federal Teaching Hospityal Gombe (FTHG) Nigeria.The result is comparably lower than the similar study conducted in the south western Nigeria, but relatively higher than the values obtained in South Africa and Ireland.

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