International Journal of Science and Technology Research Archive

ISSN: 0799-6632 (Online)

Journal homepage: https://sciresjournals.com/ijstra/

(Research Article)

Correlation between mAs and ESAK (mGy) for male and female chest x-ray in Digital radiography

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International Journal of Science and Technology Research Archive, 2023, 04(01), 001–005

Publication history: Received on 17 November 2022; revised on 27 December 2022; accepted on 29 December 2022

Article DOI: https://doi.org/10.53771/ijstra.2023.4.1.0170

Abstract

The data were collected from 350 patients, who underwent routine x-ray examinations for chest PA examination with digital imaging in the x-ray department of Alshab Teaching Hospital in Khartoum state in Sudan. During the period from November 2019 to February 2020. The data for optimization phase were collected from phantom from computed radiography, which include chest PA, chest AP in Karary University during the period from January 2020 to February 2020. It was passed successfully the extensive quality control tests performed by Sudan atomic energy commission. The objective was to correlate between mAs and ESAK (mGy) for male and female chest x-ray. The study concluded that there was a strong relationship between mAs and ESAK, also significant correlation between Age groups and incidence risk cancer and mortality.

Keywords: Correlation; MAs; ESAK (mGy); Male and female; Chest

1 Introduction

Computed radiography or "CR" became commercially available in the early 1980s, but was at first fraught with technical problems. It was found that "screens" coated with certain fluorescent materials, which had been used to convert x-ray energy into light that exposed films, could be made to glow a *second time* afterward when stimulated by laser beams. This stimulated light emission, using only the *residual energy* remaining in the screen after x-ray exposure, was very dim indeed. But, after being captured by light sensitive diodes and converted into a meagre electrical current, it could be electronically and digitally amplified before being processed by a computer to produce a bright radiographic image on a display monitor. Electricity. Direct-conversion systems convert the x-ray energy directly into electricity without the intermediate step of converting x-rays into light. In direct conversion units have the advantage of saving patient radiation dose, but direct-conversion units produce better resolution. Since these are both desirable outcomes, both types of systems continue in use (Quinn 2019).The effect of x-rays on humans is the result of interactions at the atomic level. These atomic interactions take the form of ionization or excitation of orbital electrons and result in the deposition of energy in tissue. Deposited energy can produce a molecular change, the consequences of which can be measurable if the molecule involved is critical. When an atom is ionized, its chemical binding properties change. If the atom is a constituent of a large molecule, ionization may result in breakage of the molecule or relocation of the atom within the molecule. The abnormal molecule may in time function improperly or cease to function, which can result in serious impairment or death of the cell (Stewart2017).

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2 Material and methods

2.1 Materials

This study was conducted in two phases. The pre-optimization phase involved 350 patients. The second phase, an experimental study utilized phantom (PBU-60) optimization dose and image quality.

2.1.1 The phantom

CT Whole Body Phantom PBU-60, is life-size human phantom with a life-size synthetic skeleton are embedded in radiological soft tissue substitute.

Intended application: Positioning phantom for plain radiography. Length: approx.165cm..Weight: approx. 50kg.Embedded organs: brain, eye balls, lungs with vessels, trachea, mediastinum, liver with vessels (incl. portal vein), kidneys, spleen, pancreas, stomach (air), sigmoid colon, rectum, prostate.Materials: Human tissue substitute (urethane, epoxy, etc.)

2.1.2 Machines used

The first x-ray machine used in this study was Toshiba, unit model E7239X, Ser.No 12E041, Insert model E7239, max voltage 125kv, focal spot 2.0/1.0, Permanent Filtration 0.9 AL/ 75, made in Japan. It was passed successfully the extensive quality control tests performed by Sudan atomic energy commission. The second x-ray machine used in this study was Shimadzu, unit model 0. 7U161CS-36 Ser.No 532 – 24275- 41, max voltage 125kv, focal spot 0.7, Permanent Filtration 1.5mm AL/ 70, made in Japan. It was passed successfully the extensive quality control tests performed by Sudan atomic energy commission.

2.2 Method

2.2.1 Dose measurement

Dose was evaluated using the CALDose_X 5.0 Monte Carlo software, Department of Nuclear Energy, Federal University of Pernambuco, Brazil. The incident air kerma (INAK) was estimated based on the X-ray tube output curve, and the ESAK was then calculated by multiplying this INAK value with the backscatter radiation factor. Conversion coefficient can be calculated individually for male adult phantom (MASH) and female adult phantom (FASH) using this software. The absorbed dose and ED for gender-specific organs and patient positioning can then be obtained together with cancer risk arising from the radiographic examination by means of the conversion factor.

2.3 Statistical Analysis

Data analysis was performed using SPSS, version 21 and excel office 2019.

3 Results

Table 1 The correlation between mAs, and ESAK (mGy) for male and female chest x-ray

Sex			**Pearson Correlation**	**p-value**
Male	mAs	ESAK (mGY)	0.947	0.000
Female	mAs	ESAK (mGY)	0.898	0.000

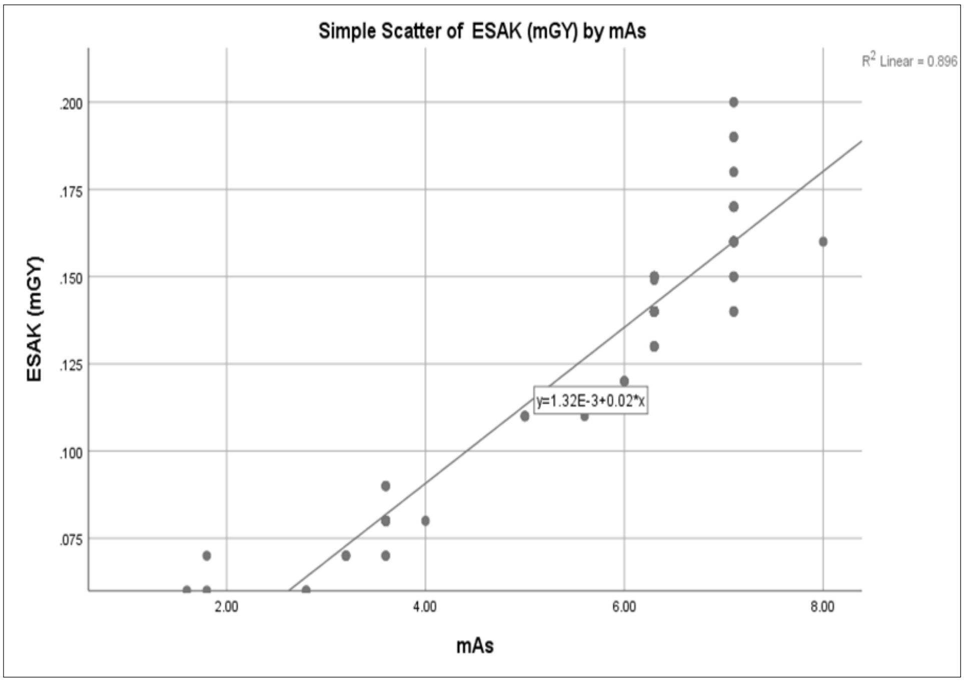

Figure 1 The correlation between mAs and ESAK (mGy) for male chest x-ray

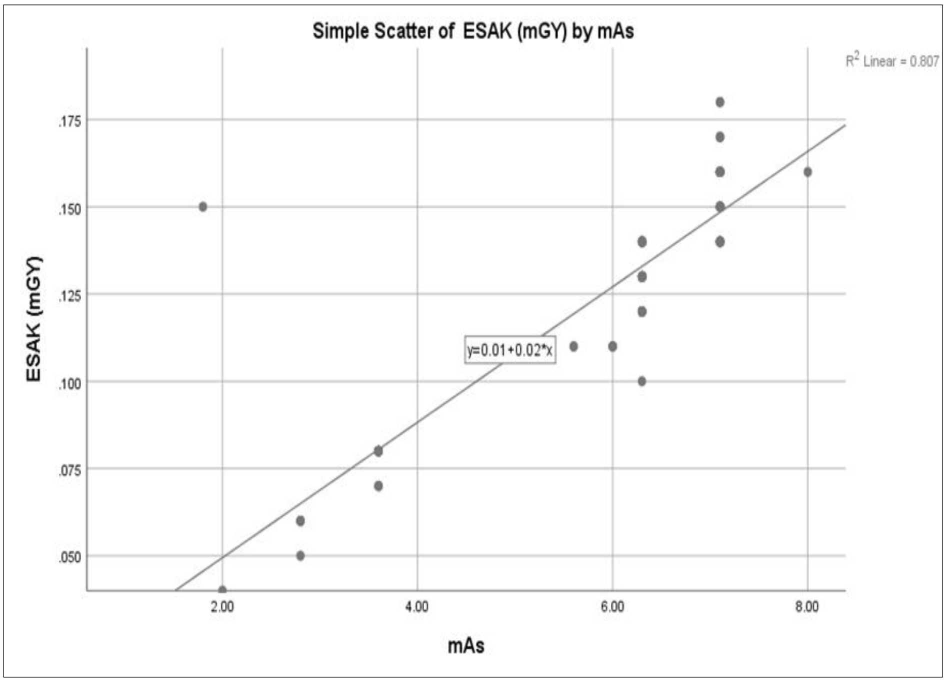

Figure 2 The correlation between mAs and ESAK (mGy) for female chest x-ray

4 Discussions

This study intended to estimate the radiation doses for patients undergoing chest PA x-ray examination. Total 350 patients 179 male and 171 female were examined. the statistical summary for exposure parameters and ESAK were recorded in tables (4-2,4-3). The ESAK was high in male (0.135±0.029mGy) than female (0.128±0.027mGy). these results agree with Chanchal Kaushik (2021) and high than Atchara (2018) but low than Hussien (2021).The correlation between mAs and ESAK (mGy) for male and female chest x-ray were rococded in table ( ). There was a strong, positive relationship between mAs and ESAK (mGY) for male, which was statistically significant (correlation Coefficient=0.947, p-value = 0.000). There was a strong, positive relationship between mAs and ESAK (mGY) for female, which was statistically significant (correlation Coefficient=0.898, p-value = 0.000). the figures (1) shown the correlation between mAs, kVp and ESAK (mGy) for male and female chest x-ray.

Tables (2) shown the Mean effective doses (mGy) at various organs for male and female chest x-ray. The lungs and skeleton were the high organ dose. Table (4-7) shown Descriptive Statistics values risk of cancers incidence (in 100,000 people) induced by radiations from chest x-ray that were high in female than male. Tables (4-8 ,4-9) shown Descriptive Statistics values risk of cancers incidence and age group for male and female. Table (4-9) and figure (4-6) shown the correlation between the age and risk or cancer incidence for male and female chest x-ray. There was a very strong, negative correlation between Age groups and incidence risk cancer for female, which was statistically significant (correlation Coefficient= -0.708, p-value = 0.000) and There was a moderate, negative correlation between Age groups incidence risk cancer for male, which was statistically significant.

5 Conclusion

The results showed that there was a strong relationship between mAs and ESAK, also significant correlation between Age groups and incidence risk cancer and mortality.

For chest PA the optimized exposure technique was identified as 1.4 mAs and enhance the image that rduce ESAK from 0.53mGy to 0.027mGy.

For chest AP the optimized exposure technique was identified as 1 mAs and enhance the image that rduce ESAK from 0.713mGy to 0.52mGY.

Compliance with ethical standards

Acknowledgments

This publication was supported by prof/ Ikhlas Abdelaziz, college of medical radiological science, Sudan University of science and technology, Khartoum, Sudan.

Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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