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Assessment of Skin Effective Dose and Radiation Risk for Chest, Abdomen and Pelvic During Conventional X-Ray Examinations

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Abstract: ***Assessment of effective skin doses and radiation risk for patients resulted from conventional x-ray examinations should be made as a means for minimizing the probability of stochastic radiation effect. Entrance skin dose was determined indirectly via generating X-ray dose output factors, back scatter factor, focus to skin distance, mAs and applied tube kV in mathematical model. The effective skin dose is calculated based on tissue weighting factor for each projection. The mean and standard deviation for effective skin doses for chest PA, abdomen, pelvic AP were 13.8 ± 0.4, 25 ± 14, 54.1± 3.3 µSv respectively. The effective skin dose calculation was giving minimum stochastic radiation effect rather than effective dose.***

Keywords: Effective dose, Skin Effective Dose, Radiation Risk, X-ray

1. Introduction

The objectives of this study were to calculate the effective skin dose and radiation risk for patients undergoing diagnostic X-ray examinations. The entrance skin dose is a measure of the radiation dose absorbed by the skin where the X-ray beam enters the patient. Entrance skin dose for some x-ray examinations were assessed by Taha *et al* 2014 [1]. Entrance skin dose for pelvic during abdomen exposure was measured by Taha *et al*, 2019 [2]. The effective skin dose is calculated by multiply the ESD by tissue weighting factor of 0.01 by International Commission of Radiological Protection, 103, 2007 [3].

2. Materials and Methods

X-ray acquisition parameters for each x-ray projection carried out using -ray Siemens model AXIOM Aristos FX plus is presented in Table 1.

Table 1: X-ray acquisition parameters.

Examination	Projection	kVp	Time	Field size, cm^2	FFD, cm	FSD, cm
Chest	PA	125	500	42 X 33	180	157-163
Abdomen	AP	83	500	42 X 33	100	73-80
Pelvis	AP	53	500	35 X 42	100	73-80

Dose output was deduced from a relation between applied kilo voltage from 30 kV to 130 Kv and dose out put that measured using Raysafe meter at focal to skin distance at one meter was generated**.** The ESD was calculated in the present work via entering parameters such as X-ray dose output, back scatter factor, focus to skin distance, FSD and physical parameters such as mAs and kV in mathematical Equation (1) used by Ofori et al, 2012 [4].

$$ESD = BSF\ X\ Tube\ Output\ x\ \left(\frac{\mu Gy}{mAs}\right) X\ \left(\frac{100}{FSD}\right)^2\ X\ mAs \quad (1)$$

Where backscatter factor, BSF was taken from International Atomic Energy Authority, IAEA,2007 [5] mAs is the product of the tube current (mA) for each x-ray projection. The effective skin dose is calculated by multiply the ESD by tissue weighting factor of 0.01 [3].

3. Results and Discussion

Table 2 presents distribution of the mean and standard deviation values of skin effective dose, effective dose and effective skin dose for individual patient exposures for the three projections .

Table 2: ESD (mGy), Effective dose (µSv) and Skin Effective Dose (µSv) for Chest PA, Abdomen and Pelvic AP.

Projection	ESD, mGy	Effective dose, µSv	Skin Effective dose, µSv
chest PA	0.14 ± 0.04	18 ± 5.20	1.4 ± 0.04
Abdomen	2.50 ± 0.14	300 ± 16.80	25 ± 1.40
Pelvic AP,	5.41 ± 0.33	811 ± 49.50	54 ± 3.30

The additional cancer risk for x-ray examination was calculated using onlinexrayrisk software as presented in Table 3.

Table 3: Additional cancer risk for chest, abdomen and pelvic examinations

X-ray Examination	Additional cancer risk %	
	Effective dose	Skin effective dose
Chest	0.000007	0.000120
Abdomen	0.000166	0.001997
Pelvic	0.005399	0.05399
Total additional cancer risk %	0.005572	0.007516

4. Discussion

The mean entrance skin dose, ESD for chest PA, , abdomen, and pelvic AP were found to be 0.14 ± 0.048mSv, 2.50 ± 0.14 mSv and 5.41 ± 0.33 mSv respectively which lower than the diagnostic entrance skin dose, ESD that recorded by European Committee, 2002 [7].The mean effective dose for chest PA, , abdomen and pelvic AP were found to be 18 ±

5.2 µSv , 300 ± 16.8 µSv and 811 ± 49.5 µSv respectively which lower than the recommended dose limit for occupational workers with minimum stochastic risk and tissue weighting factors are taken into considerations as stated in ICRP-118[6].The mean effective skin dose for chest PA, abdomen, and pelvic AP were found to be 1.4± 0.04 µSv , 25 ± 1.4 µSv and 54 ± 49.5 uSv respectively which lower than the recommended dose limit for public with minimum stochastic risk due to skin tissue weighing factor equals 0.01 as mentioned before in ICRP-103 [3].Table 2 indicates that total additional radiation cancer risk resulted from effective dose and skin effective dose of a chest, abdomen and pelvic. It is clear that total additional radiation cancer risk resulted from effective dose is equal to one in 17947 chances or 99.9944% chance of having no effect of the above studies. It is clear that total additional radiation cancer risk resulted from skin effective dose is equal to one in 13305 chances or 99.9924% chance of having no effect of the above studies. [8].

5. Conclusion

Indirect method for assessment of skin effective dose for chest, abdomen and pelvic

During conventional x-ray examinations was created. The effective skin dose calculation was gaveminimum stochastic radiation effect.

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