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Radiation dose measurement and environmental surveying during x-ray imaging and fluoroscopy at general hospital in Sulaimania-Kurdistan region-Iraq

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Abstract

Radiation dose (rates) measurement and environmental surveying in X-ray units are essential to ensure that the radiographers and the visitors to the hospitals are not received excess X-ray. In the present study the dose rates were measured at radiographers place and in the front of the direct door of X-ray room during X-ray imaging and fluoroscopy at General Hospital in Sulaimania and visual inspection for radiographer's facilities were checked. High dose rates were recorded during X-ray and fluoroscopy and the issue of safety for the workers did not exist. The responsible of the hospital was informed about the results.

Keywords: *Dose rates, environmental surveying, fluoroscopy, X-ray.*

1 Introduction

Since the end of the 19th Century, man has learned to use radiation for many beneficial purposes. Today, many sources of radiation, such as x-ray machines, linear accelerators and radionuclides are used in clinical and research applications. Such beneficial uses may at times create potentially hazardous situations for personnel who work within the hospital [1].

X-ray is used daily in hospitals and clinics to perform diagnostic imaging procedures and radiographers are occupationally exposed at low-level dose and dose rate (external exposure) to X- rays, so if they do not apply the rules of radiation protection may be receive excess dose during their lifetimes. Any increment of exposure above the natural background levels will produce a linear increment of risk [2]. Radiation workers are predicted to have a greater percentage risk of developing detrimental effects over the general public because of their generally greater exposure [3]. It has been proved that ionizing radiation produces Reactive Oxygen Series (ROS) in biological system capable of destroying biomolecules such as DNA, lipids, proteins and carbohydrate (4). Increased frequencies of chromosome aberrations and micronuclei are well known among individuals occupationally exposed to ionizing radiation [5, 6, 7, 8, and 9] and high levels of chromosomal aberrations in the lymphocytes of medical staff occupationally exposed to X-rays were reported by Kasuba et al. [10]. Lalic et al. and Cheriyan et al. [11, 12] observed a high incidence of chromosomal aberrations in human population from southwest coast of India who were exposed to low level natural radiations. In another study high incidence of leukemia and genetic abnormalities were observed by Schubauer et al. [13] in the workers and patients exposed to therapeutic radiation.

Interactions between ionizing radiation and DNA produce different types of DNA lesions, including damage to nucleotide bases, DNA–DNA and DNA–protein crosslinks and alkali-labile sites, as well as SSBs and DSBs [3].

The purpose of environmental surveying and radiation dose measurement in the present study is to estimate the radiation exposure to the radiographers and visitors in the hospital.

2 Materials and methods

Calibrated nuclear radiation meter palm RAD 907 was used for measuring the dose rate at the place of radiographers and directly door of X-ray at general hospital in Sulaimania city-Kurdistan region-Iraq. Each of the dose rates in the tables was subtracted from the background of the places (background of place shows under the tables) and visual inspection for radiographer's facilities were checked. We discussed with most of the radiographers and works about principle of radiation protection in their departments.

3 Results and discussion

Table (1) shows information of the X-ray machines. The one which used for fluoroscopy was manufactured twenty years ago while the other for routine X-ray was manufactured seven years ago. Table (2) shows general information about radiation protection tools. It is very important to estimate absorbed doses from individuals occupationally exposed to ionizing radiation in order to carry out radioprotection procedures and restrict the hazards to human health [14]. It was observed for both fluoroscopy and X-ray the radiographers were not using lead dress and paws during imaging and no one has personal monitoring badge which it is essential for protecting form X-ray. Both Deterministic and stochastic effects may result after exposure to X-ray. If radiographers work in violation of hospital safety policies and procedures they are at risk of deterministic effect. Some stochastic effects would be cancer and genetic mutation from occupational exposure to X-rays. These effects usually appear after a long time [3].
Table (3) shows information of fluoroscopy and X-ray rooms, after discussing with the workers it appears that these rooms at the beginning are not built for these purposes, so the places are poor for radiation protection.

Table 1: X-ray machine information

Examination type	Machine name	Made in	Type of machine	Work	Tube
Fluoroscopy	Siemens	Italy (1993-1994)	Const.	Electronic	Standard
X-ray	Shimadzu	Japan (2006)	Const.	Electronic	Standard

Table 2: General observation of radiation protection tools

Examination type	Lead dress for radiographic		Paws		Lead dress for patient		Glass lead		Personal monitoring badge		Room light
	using	Non using	using	Non using	using	Non using	exist	Not exist	using	Non-using	
Fluoroscopy		*		*		*	*			*	OK
X-ray		*		*		*	*			*	OK

Table 3: X-ray rooms information

Examination type	Room dimension/ cm	Width of wall/cm	Number of windows	Number of doors	Ventilation
Fluoroscopy	601 x 707	28	0	1	0
X-ray	450 x 421	16	0	1	1

The dose rates measurement at radiographers place and in front of the direct X-ray room for routine X-ray imaging recorded in tables (4 a, b). These data obtained after subtracted from the background of the place. Most of high dose rates were in front of the direct X-ray room because the door was not lined lead completely there was some leaking under the door so the people which pass there may exposed to this dose rate. The maximum dose rate for this place was 0.339 μSv/hr which almost three times more than the background of the place. However high dose rate was not recorded for the radiographer place but the problem with the unit was the radiographers do a lot of X-ray imaging in one day and most of them have private units for X-ray imaging outside the hospital, so they receive a lot of low doses per day may lead to stochastic effect in the future.
The data for dose rate of fluoroscopy tabulated in table (5). It contains one case, only for radiographer place because the place was not safe and built inside the room which was not isolated completely. For this case maximum dose rate was 1.280 μSv/hr which is almost fourteen times more than background of the place. Diagnosis by fluoroscopy it take more time than routine X-ray, the table also shows the dose rate at the place during swallow of barium which is low but should be taken in to account.
One of another notes in this department of the hospital was two categories of personnel are not exist; medical physicist and record officer

Table (4 a): Dose rate measurement at different places

Part of body	Position	Point of interest	Dose rate (μSv/hr)
Skull	A.P	Place for standing radiographic	0.018
		Direct in front of door	0.095
	Lat	Place for standing radiographic	0.026
		Direct in front of door	0.125
Shoulder Cervical spine	A.P	Place for standing radiographic	0.020
		Direct in front of door	0.063
	Lat	Place for standing radiographic	0.017
		Direct in front of door	0.119
Chest	P.A	Place for standing radiographic	0.058
		Direct in front of door	0.174
	Lat	Place for standing radiographic	0.039
		Direct in front of door	0.293
Humerus	A.P	Place for standing radiographic	0.021
		Direct in front of door	0.116
Elbow	A.P	Place for standing radiographic	0.012
		Direct in front of door	0.047
	Lat	Place for standing radiographic	0.003
		Direct in front of door	0.107
Knee Leg Foot	A.P	Place for standing radiographic	0.015
		Direct in front of door	0.114
	Lat	Place for standing radiographic	0.014
		Direct in front of door	0.086
Hand Wrist	A.P & Lat	Place for standing radiographic	0.026
		Direct in front of door	0.131
Femur	A.P	Place for standing radiographic	0.032
		Direct in front of door	0.117
	Lat	Place for standing radiographic	0.017
		Direct in front of door	0.099

Table (4 b): Dose rate measurement at different places

Part of body	Position	Point of interest	Dose rate (μSv/hr)
Forearm	A.P & Lat	Place for standing radiographic	0.048
		Direct in front of door	0.122
Abdomen	A.P	Place for standing radiographic	0.021
		Direct in front of door	0.240
Pelvis	A.P	Place for standing radiographic	0.029
		Direct in front of door	0.152
Kidney Ureter Bladder (K.U.B)	A.P	Place for standing radiographic	0.015
		Direct in front of door	0.185
Lumbar sacral spine	A.P	Place for standing radiographic	0.030
		Direct in front of door	0.309
	Lat	Place for standing radiographic	0.003
		Direct in front of door	0.285
Thoracic vertebrae	A.P	Place for standing radiographic	0.026
		Direct in front of door	0.264
	Lat	Place for standing radiographic	0.018
		Direct in front of door	0.339

Background = 0.086 μSv/hr (Place for standing radiographic)
Background = 0.124 μSv/hr (Direct in front of door)

Table 5: Dose rate measurement at radiographer place for fluoroscopy

Part of body	Position	Point of interest	Dose rate (μSv/hr)
Lumbar sacral spine	A.P	Place for standing radiographic	1.280
	Lat	Place for standing radiographic	1.187
Intravenous urography (I.V.U) Barium meal B.enema B.follow through	A.P	Place for standing radiographic	0.116
Barium swallow	A.P	Place for standing radiographic	0.059

Background = 0.088 Sv/hr (Place for standing radiographic)

4 Conclusion

Radiation protection of the radiographers and the visitors are not taken into account in the hospital. Excess dose rate at the places may increase the stochastic effects in the future, so the responsible of the unit was informed about the results.

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