QUILTY CONTROLAND RADIATION DOSE RATES MEASURMENT FROM DIAGNOSTIC X-RAY EXAMINATION AT DIFFERENT PLACES OF HOSPITALS IN SULAIMANIA

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ABSTRACT
The purpose of this study was to measure the dose rates of X- ray at radiographer's place, directly door of x-ray room, waiting room during X- ray imaging, fluoroscopy and quality control test for radiographic facility with visual inspection at 4 hospitals in Sulaimania city. The results show that the facilities for safety did not exist in all hospitals. High dose rates were recorded for x-ray and fluoroscopy in most of the hospitals. At the end of our work at each hospital the responsible of the department informed about the results at all places.

Keywords: *Dose rate, exposure, radiation protection, radiation, x-ray imaging.*

1. INTRODUCTION

Ionizing radiations are widely used in diagnostic and therapeutic medical imaging. Medical radiation workers are employees of hospitals, clinics and private offices where radiation is used in the process of delivering health care to humans. They may be receiving low doses of X-ray during periods of time.

X-ray is the largest man-made source of ionizing radiation to the world population (ICRP, 1991; UNSCEAR, 1993).It is the major contributor to the effective dose of both the patient and the personnel[Muhogora and Nyanda, 2001]. Any increment of exposure above natural background levels will produce a linear increment of risk [Wall et al., 2006]. Leukemia and some types of cancers like thyroid, breast and lung strongly associated with exposure to ionizing radiation. However, developing of cancers depending of some factors including the age and the amount receiving dose [Bhatai,et al., 1983, Oluwafisoye et al., 2009].
It was found that medical workers who were occupationally exposed to ionizing radiation for different periods of time showed highly significant increases in levels of DNA damage compared with controls [Vera Garaj-Vrhovac1 and Nevenka Kopjar,2003]. Samera M. Sallam concluded that Even at low levels of exposure to X-rays may have oxidizing effect on erythrocytes, which must be taken into account for workers operating on X –rays equipment [Samera M Sallam, 2011]. Jha and Sharma reported enhanced frequency of chromosome aberrations in workers occupationally exposed to diagnostic X-rays[Jha, A.N. and Sharma, T., 1991].JasminkaBatanjac found that the workers in the protection department which exposed to low level of ionizing radiation below permissible limit of 50 mGy/year for the whole body have higher frequency of dicentrics and acentrics than in the control group [JasminkaBatanjac, 2000].Birutė Gricienė1andGražina Slapšytė1 determines increased frequencies of chromosome aberrations in lymphocytes of medical personnel occupationally exposed to level of radiation did not exceed annual dose limit (20 mSv of the effective dose [BirutėGricienė and Gražina Slapšytė1, 2007].

The dose limits for staff were published by the International Commission on Radiological Protection (ICRP) in 1977 and subsequently in the ionizing radiation regulations. The effective annual dose limit was formerly 50mSv and the newly adopted effective annual dose limit is 20mSv averaged over five years [ICRP, 1991].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 (Ramalho*et al.*, 1998)

This study was performed to measure the dose rates at different places of x-ray department and Quality control test of X- ray facilities at 4 hospitals in sulaimania. It was done in order to ensure that the workers are safe during their daily life and the patients did not receive excess radiation when they are in waiting rooms.

In our next study we will work to show the frequencies of chromosome aberrations in lymphocytes of radiographers in these hospitals.

2. MATERIALS AND METHODS

The study was done at 4 hospitals in Sulaimania city-Kurdistan region-Iraq. For measuring the dose rate at the place of radiographers, directly door of X-ray and waiting rooms, the calibrated nuclear radiation meter palm RAD 907 was used fig.(1), which measure the rates of Alpha, Beta, X and Gamma radiations. Each of the dose rates in the tables was subtracted from the background of the places (background of place shows under the tables). We discussed with most of the radiographers and works about principle of radiation protection in their departments.

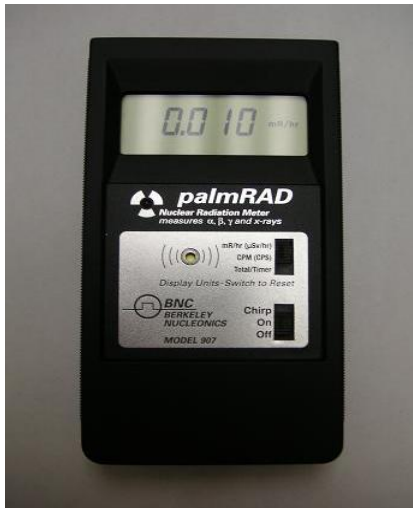

Figure 1;palm RAD 907

3. RESULTS AND DISCUSSION

Table (1.a) shows the model and the year of manufacture of the machines. The table shows that the X-ray machine of Teaching Hospital and fluoroscopy of the Imaging Center were manufactured twenty years ago while the fluoroscopy of the Teaching Hospital and X-ray machine of Emergency Hospital were manufactured twelve years ago and the X-ray machine of ShahidDr.Aso was manufactured eleven years ago. Table(1.b) shows general information about radiation protection tools; we notice in all hospitals, the radiographers and patients do not use the lead dress during X-ray examination which is very important to protect them from X-ray. Three of the hospitals use gloves, but these types of gloves are not protect against X-ray radiation and Emergency Hospital has not glass lead to see the patient during X-ray imaging. Table (1.c), shows the X-ray room information. All hospitals have different dimensions, this mean that the rooms did not built at a standard dimensions. In Imaging Center, the room has two doors and Emergency Hospital has three doors, more than one door increases the probability for leaking the radiation if they are not lined tightly. Only two of the hospitals have one window and two of them contain ventilation. The table also shows that radiographers in all hospitals were not using personal monitoring badge, this mean that no one knew how much radiation received during a period of time which is very dangerous for their health. Personal monitoring is essential, since there is a link between the ionizing radiation and generation of reactive oxygen series (ROS)[Cohen, B.L., 2002.]. One of the main sources of free radicals is the radiations which capable of destroy biomolecules such as DNA, proteins and carbohydrate.[Olisekodiaka et al.,2009].

One part of quality control program for radiographic facility is visual inspection [Oluwafisoye et al., 2010], the above three tables refer to this part.

Table 1.a ; X-Ray Machine Information

Name of hospital	Examination type	Machine name	Made in	Type of machine	Work	Tube
Teaching hospital	X-ray	Siemens	Italy (1993-1994)	Const.	Electronic	Standard
	Fluoroscopy	Siemens	Germany (2001)	Const.	Electronic	Standard
ShaheedDr.Aso hospital	X-ray	Siemens	Germany (May 2002)	Const.	Electronic	Standard
Imaging center	Fluoroscopy	Siemens	Germany (1993-1994)	Const.	Electronic	Standard
Emergency hospital	X-ray	Siemens	Germany (2001)	Const.	Electronic	Standard

Table 1.b; General observation of Radiation Protection tools.

Name of hospital	Examination type	Lead dress for radiographic		Paws		Lead dress for patient		Glass lead		Room light	Personal monitoring badge	
		using	Non using	using	Non using	using	Non using	exist	Not exist		using	Non using
Teaching hospital	X-ray		*	*			*	*		good		*
	Fluoroscopy		*	*			*	*		good		*
ShaheedDr.Aso hospital	X-ray		*		*		*	*		good		*
Imaging center	X-ray		*		*		*	*		good		*
Emergency hospital	X-ray		*	*			*		*	good		*

Table 1.c;: X-Ray rooms information

Name of hospital	Examination type	Room dimension/ cm	Width of wall/cm	Number of windows	Number of doors	Ventilation	Diaphragm
Teaching hospital	X-ray	610 x 383	30	1	1	1	2
	Fluoroscopy	525 x 720	24	0	1	1	2
ShaheedDr.Aso hospital	X-ray	475 x 690	34	0	1	0	2
Imaging center	Fluroscopy	630 x 560	30	0	2	0	2
Emergency hospital	X-ray	415 x 620	33	1	3	0	2

Table(2), shows measurement of the dose rate at radiographer and waiting places in Emergency Hospital, during X-ray imaging for different parts of the body. Comparing the dose rate at these places with the background was not too much, these conditions are safe for radiographers and the patient in the waiting room, but the problem was the radiographers took many X-ray imaging in one day, so if collect all these dose rate may be produce risk on their health in the future.

Table 2; Dose rate measured at different places in Emergency Hospital

Part of body	Position	Point of interest	Dose rate (μSv/hr)
Skull Chest Cervical spine Thoracic vertebrae	A.P	• Place for standing radiographic	0.131
		• Place for waiting patient	0.008
	Lat	• Place for standing radiographic	0.183
		• Place for waiting patient	0.015
Limbs Wrist Hand Humerus Elbow Forearm Knee Leg Foot	A.P	• Place for standing radiographic	0.062
		• Place for waiting patient	0.009
Kidney Ureter Bladder (K.U.B)	A.P	• Place for standing radiographic	0.113
		• Place for waiting patient	0.054
Shoulder	A.P	• Place for standing radiographic	0.018
		• Place for waiting patient	0.020
Femur	A.P &Lat	• Place for standing radiographic	0.128
		• Place for waiting patient	0.015
Pelvis	A.P	• Place for standing radiographic	0.131
		• Place for waiting patient	0.003
	Lat	• Place for standing radiographic	0.005
		• Place for waiting patient	0.068
Lumbar sacral spine Abdomen	A.P	• Place for standing radiographic	0.035
		• Place for waiting patient	0.039
	Lat	• Place for standing radiographic	0.081
		• Place for waiting patient	0.030

Background = 0.131 μSv/hr (Place for standing radiographic)
Background = 0.0815 μSv/hr (Place for waiting patient)

Table(3) shows the dose rate measurement for fluoroscopy in the Imaging Center, comparing the dose rates with background of the place, the maximum dose rate was 0.605μSv/hr which four times than the background. The radiographer might expose to this dose rate more than one time in the same day, so he receive a large dose in a day.

Table 3; Dose rate measured at different places using Fluoroscopy –in imaging center

Part of body	**Position**	**Point of interest**	**Dose rate (μSv/hr)**
K.U.B	A.P	• Place for standing radiographic	0.605
		• Direct in front of door	0.023
Knee	A.P &Lat	• Place for standing radiographic	0.023
		• Direct in front of door	0.152
Chest	P.A	• Place for standing radiographic	0.150
		• Direct in front of door	0.011
	Lat	• Place for standing radiographic	0.475
		• Direct in front of door	0.039
Shoulder Cervical spine	A.P	• Place for standing radiographic	0.074
		• Direct in front of door	0.012
Lumber sacral spine	A.P	• Place for standing radiographic	0.093
		• Direct in front of door	0.152
	Lat	• Place for standing radiographic	0.538
		• Direct in front of door	0.021
Abdomen	A.P	• Place for standing radiographic	0.062
		• Direct in front of door	0.047
	Lat	• Place for standing radiographic	0.475
		• Direct in front of door	0.035

Background = 0.145 μSv/hr (Place for standing radiographic)
Background = 0.152 μSv/hr (Direct in front of door)

The dose rates measurement during X-ray imaging and fluoroscopy in the Teaching Hospital are in the tables (4.a , 4.b) respectively. The maximum dose rate was recorded during fluoroscopy (0.558 μSv/hr) comparing with background, it was almost ten times more.

Table 4.a; Dose rate measured at different places in Teaching Hospital

Part of body	Position	Point of interest	Dose rate (μSv/hr)
Skull	A.P	• Place for standing radiographic	0.059
		• Place for waiting patient	0.046
	Lat	• Place for standing radiographic	0.060
		• Place for waiting patient	0.065
Cervical spine	A.P	• Place for standing radiographic	0.058
		• Place for waiting patient	0.053
	Lat	• Place for standing radiographic	0.056
		• Place for waiting patient	0.060
Chest	P.A	• Place for standing radiographic	0.030
		• Place for waiting patient	0.041
	Lat	• Place for standing radiographic	0.017
		• Place for waiting patient	0.050
Lumbar sacral spine	A.p	• Place for standing radiographic	0.005
		• Place for waiting patient	0.050
	Lat	• Place for standing radiographic	0.024
		• Place for waiting patient	0.048
Abdomen Erect	A.P	• Place for standing radiographic	0.033
		• Place for waiting patient	0.054
	Lat	• Place for standing radiographic	0.060
		• Place for waiting patient	0.033
Kidney Ureter Bladder (K.U.B)	A.P	• Place for standing radiographic	0.060
		• Place for waiting patient	0.035
Lumbar sacral spine	A.P	• Place for standing radiographic	0.005
		• Place for waiting patient	0.050
	Lat	• Place for standing radiographic	0.024
		• Place for waiting patient	0.048
Thoracic vertebrae	A.P	• Place for standing radiographic	0.044
		• Place for waiting patient	0.035
	Lat	• Place for standing radiographic	0.074
		• Place for waiting patient	0.057
Pelvis	A.P	• Place for standing radiographic	0.029
		• Place for waiting patient	0.039
	Lat	• Place for standing radiographic	0.053
		• Place for waiting patient	0.042

Background = 0.056 μSv/hr (Place for standing radiographic)
Background = 0.0515 μSv/hr (Place for waiting patient)

Table 4.b; Dose rate measured at different places using Fluoroscopy in Teaching Hospital

Part of body	**Point of interest**	**Dose rate (μSv/hr)**
Abdomen	• Place for standing radiographic	0.026
	• Place for waiting patient	0.057
Lumbar sacral spine	• Place for standing radiographic	0.262
	• Place for waiting patient	0.032
Kidney	• Place for standing radiographic	0.558
	• Place for waiting patient	0.071

Background = 0.058 μSv/hr (Place for standing radiographic)
Background = 0.069 μSv/hr (Place for waiting patient)

The data of dose rates for Shaheed Dr. Aso Hospital tabulated in table (5),, the problem in this hospital in most cases the dose rate was high in front of the X-ray room directly, the maximum value was 1.864 μSv/hr, which nineteen times more than the background of this place, because the door that leads to the X-ray room was not efficiently lead lined.

Table 5; Dose rate measurement in Shaheed Dr. Aso Hospital

Part of body	**Position**	**Point of interest**	**Dose rate (μSv/hr)**
Skull Humerus Cervical spine Shoulder Chest	A.P	• Place for standing radiographic	0.065
		• Direct in front of door	0.097
	Lat.	• Place for standing radiographic	0.091
		• Direct in front of door	0.213
Hand Elbow Wrist Foot Forearm	A.P	• Place for standing radiographic	0.021
		• Direct in front of door	0.035
	Lat.	• Place for standing radiographic	0.021
		• Direct in front of door	0.035
Knee Ankle Leg	A.P	• Place for standing radiographic	0.029
		• Direct in front of door	0.020
	Lat.	• Place for standing radiographic	0.029
		• Direct in front of door	0.020
Sacrum	A.P	• Place for standing radiographic	0.116
		• Direct in front of door	0.688
Lumber sacral spine Abdomen Erect Pelvis Femur K.U.B	A.P	• Place for standing radiographic	0.038
		• Direct in front of door	0.937
	Lat.	• Place for standing radiographic	0.038
		• Direct in front of door	1.864
Thoracic vertebrae	A.P	• Place for standing radiographic	0.018
		• Direct in front of door	0.202
	Lat.	• Place for standing radiographic	0.047
		• Direct in front of door	0.354

Background = 0.091 μSv/hr (Place for standing radiographic)
Background = 0.097 μSv/hr (Direct in front of door)

4. CONCLUSION

From the above results we concluded that the issue of the safety of workers and patients are not taken into account in the X-ray unit at all hospitals and the quality control through visual inspection is inadequate, so at all hospitals the responsible was informed about the safety in their department.

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