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Radiation protection evaluation from radio diagnostic departments in Erbil hospitals

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Saeed Nadhim Younis * Runak Taher Ali ** Sameeah Abdulrahman Rashid *

Abstract

Background and objective: Radiation is used in some aspects of medicine, researches and in industries. These radiation applications are useful to society. However radiation can also have detrimental effects. It was important to establish rules and resolutions governing these uses to balance the positive against the negative effects. Dose limits have been established for groups who use radiation in their work as well as for population at large. The rules used in most countries have been worked out by the International Commission on Radiological Protection (ICRP). The aim of this study was to evaluate the radiation protective measures in different diagnostic radiological departments in Erbil hospitals.

Methods: Data on the number of diagnostic procedures using x-ray examinations in five hospitals were collected. The palm RAD 907 Nuclear Radiation Meter and Contamination Monitor CoMo 170 were used to measure radiation leakage. Questionnaire was also used to elicit information from the most senior personnel of the hospital.

Results: The finding showed that the facilities for safety were grossly inadequate and the dose rates of 16.4μSv/hr and 20μSv/hr were recorded at places for paramedics and technician room respectively. Dose rates in front of window of the monitor room was 113μSv/hr and in the reception was 20μSv/hr indicating higher health risk to the paramedic, visitors and personnel at the hospital.

Conclusion: Radiation protection facilities in the radiological departments of Erbil hospitals are in general poor including both public & private sectors indicating high health risk to the paramedics, visitors and personnel at the hospitals .

Keywords: Radiation protection, Dosimeters, CT-scan, amount of radiation.

Introduction

Diagnostic x-rays are the largest man made sources of radiation exposure to the population, contributing to about 14% of the total annual exposure worldwide from all sources. Although diagnostic x-ray provides great benefits, its use carries some risks of developing cancer[1]. Medical imaging has led to rapid increases in a number of high dose x-ray examinations performed with significant consequences for individual patient doses and for collective dose to the population as a whole. It is therefore important in each country to make regular assessments of the magnitude of these large doses [2-3]. Personnel radiation monitoring is essential to ensure that dose limits for staff are not exceeded. The dose limits for staff were published by the International Commission on Radiological Protection (ICRP) in 1977 and subsequently in the ionizing radiation regulations. A downward revision was done in 1991 by re-evaluation of data on risks. The effective annual dose limit was formerly 50mSv and the newly adopted effective annual dose limit is 20mSv averaged over five years[4]. The decrease in radiation dose of patients undergoing diagnostic x-ray has a significant value. The United Nations Scientific Committee on the Effects of Atomic Radiation, in its 1972 report, says that the protection of the patient is probably the greatest factor in

* Department of surgery, College of medicine, Hawler Medical University, Erbil, Iraq.
** Department of biophysics, College of Medicine, Hawler Medical University, Erbil, Iraq.

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control of population exposures. The aim is not only to reduce the radiation exposure of individuals but also to have procedures carried out with maximum efficiency so that there can be continuing increase in medical benefits accompanied by a minimum radiation exposure[5-6]. Patients and medical personnel receive various doses of ionizing radiation from both naturally occurring and man made sources. The level of doses received depends on the occupation, level of radiation in the environment and where an individual lives. Depending on where an individual lives, most people receive an exposure in the range of 1mSv Rem per year from cosmic radiation, outer space and from naturally occurring isotopes in the ground, air, food and water. Nevertheless, X-ray examinations are common and contribute by far to the largest man made source of ionizing radiation exposure for the population[7]. More than ever before, in the recent times, there has been a constant increase in the number and frequency of X-ray examinations[8] because of the increase in availability of the X-ray facilities in developing countries. In Kurdistan region, almost every governorate owned hospital has at least an X-ray unit. The Teaching Hospitals and medical centers have between two and four X-ray units. A private hospital has at least an X-ray unit. In some Teaching and private hospitals there are Computer Tomography (CT) units. The dosimeter readings are kept as records for staff members for the purpose of evaluating their radiation history and possible risks involved. The records help in improving radiation protection practices in clinical settings. At the Washington State University, employees who have not had a radiation monitoring badge before must apply for and receive one before starting work involving radiation exposure[9]. The (ICRP) has adopted the following principle for use of the radiation; (1) The application of radiation should be useful, and (2) The radiation dose should be as low as reasonable achievable (ALARA). Background radiation is the ubiquitous ionizing radiation that the general population is exposed to, including natural and artificial sources, each of which varies by location[10]. The ICRP also suggests following values:

Radiation workers: The limit is 20mSv/y.

Averaged 5 year: The dose should not exceed 50mSv for one particular year.

The population: Radiation, except for background radiation should not exceed 1mSv/y.

Based on the above principles, our aim was to evaluate radiation protective measures in the radiology departments of Erbil hospitals.

Methods

Data were collected in a number of diagnostic X-ray examination units in the public and private hospitals and diagnostic center in Erbil, Kurdistan Region Government in the period between April, 2011 and February, 2012. The environmental radiation monitoring in this study was carried out using calibrated radiation monitor device palm RAD 907 Nuclear Radiation Meter and Contamination Monitor CoMo 170 device that measures the rate of the x-ray radiation, Figure 1. The Palm RAD 907 measures the rate of the following types of nuclear radiation (Alpha, Beta, and Gamma & X- ray radiation). A questionnaire was also used by two of the authors to elicit information from the most senior personnel of the hospital about using lead dress by the radiographers & patients or their attendance during radiation exposure, paws, glass lead and the presence or absence of alarm room light .

Figure 1: palm RAD 907 and *CoMo 170*.

Results

Table1 shows the X-ray machine specific data. The data show that the X-ray machines manufactured more than 15 years ago and all machines are working electronically except one of them is working manually. Tables 2, 3, 4, 5 and 6 indicate the measured dose rate value in μSv/hr at different hospitals and locations within and around the X-ray rooms. The measured values show that the measured dose rate at four to five different points were far above the background dose rate. The dose rate measured at the staff room was (16.4μSv/hr and 20 μSv/hr) which is far above the background radiation dose rate.

Table 1: X-Ray Machine information.

Name of Hospital	***Name of Instruments***	***Name of machine***	***Type of machine***	***Type of Working***	***Type of Tube***
A	CT – Scan	Philips	Constant	Electronically	Standard
	Angio Room	Philips	Constant	Electronically	Standard
	X – Ray	Philips	Constant	Electronically	Standard
B	Mammography	Siemens	Constant	Electronically	Standard
	Angio Room	Siemens	Constant	Electronically	Standard
	CT – Scan	Siemens	Constant	Electronically	Standard
	X – Ray	Siemens	Constant	Electronically	Standard
C	CT – Scan	Siemens	Constant	Electronically	Standard
	X – Ray	Siemens	Constant	Electronically	Standard
D	Angio Room	Philips	Constant	Electronically	Standard
	X – Ray	Philips	Constant	Electronically	Standard
E	CT – Scan	Siemens	Constant	Electronically	Standard
	X – Ray	Philips	Constant	Electronically	Standard
	Mammography	Philips	Constant	Electronically	Standard

Table 2: Dose rate measured at different location in (A) hospital.

Name of Equipment	**Point of Interest**	**Dose Rate (μSv/h)**	
		Palm rad	**Como Monitor**
CT - Scan	In front of technician table	0.91	25.7
	In front of window	113	0.2
	Doctor Room (door)	0.28	180
	Staff room	16.4	
	main door	0.28-70	0.16
X – ray	In front of technician table	0.46	110
	In front of window	0.1	36.4
	main door	0.3	53
	Doctor Room (door)	0.28	18
	Reception Room	0.13	0.26
Angio (1)			
	main door (flouro)	1.12	216
	main door (cine)	0.93	148
	window (flouro)	11.91	880
	window (cine)	12.6	706
Angio (2)			
	window (flouro)	0.113	176
	window (cine)	0.107	107
	main door	0.137	4020

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Table 3: Dose rate measured at different locations in (B) hospital.

Name of Equipment	Point of Interest		Dose Rate (µSv/h) Palm rad	Como Monitor
CT - Scan		In front of technician table	0.5	11
		In front of window	0.2	3
		main door	0.73	21
Mammography		In front of technician table	0.125	0.09
		In front of window	0.12	0.09
		main door	0	0
X – Ray	Flouro	In front of technician table	1.6	3
		In front of window	5.9	3
		main door	1.43	3
	Maltex	In front of technician table	0.2	0
		In front of window	0.7	0
		main door	0.3	5

Table 4: Dose rate measured at different locations in (C) hospital.

Name of Equipment	Point of Interest		Dose Rate (µSv.) Palm rad	Como Monitor
angio	(Flouro)	staff room	0.16	0.1
		In front of window	0.13	0.2
		main door	6.7	0.1
		inside room	2.52	2.2
	(X- Ray)	staff room	0.23	0.3
		In front of window	10.6	0.1
		main door	0.203	21
		inside room	9.5	45

Table 5: Dose rate measured at different locations in (D) hospital.

Name of Equipment	Point of Interest	Dose Rate (µSv/h) Palm rad	Como Monitor
CT - Scan	In front of technician table	0.13	0.2
	In front of window (down)	0.16	0.4
	In front of window (up)	7	10
	main door	1.42	3.4
X – ray	In front of technician table	0	0
	In front of window (down)	0	0
	In front of window (up)	0	0
	main door	0.24	0.4
	Doctor Room (door)	0.171	0.2
	Reception Room (open door)	0.2	0.4
	Reception Room (closed door)	0.2	0.2

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Table 6: Dose rate measured at different locations in (E) hospital.

Name of Equipment	Point of Interest	Dose Rate (µSv/h) Palm rad	Como Monitor
CT – Scan	In front of table	0.1	76.6
	main door	11.0-20.0	63.3
	Reception	20	24.6
Mammography	In front of table	8	170
X – Ray	In front of table	3.8-5	123

Table 7 shows the general observation in terms of facilities for radiation safety within and around the X-ray rooms. The quality control test of X-RAY machine for accuracy, consistency and reproducibility is done at least once a year. The test for kVp accuracy, kVp consistency and timer accuracy were outside the acceptable limit.

Table 7: General observation of Radiation Protection tools.

Hospital	Lead dress for radiographic		Gloves		Lead dress for patient		Lead Glass		Room light
	using	Non using	Using	Non using	using	Non using	Exist	Not exist	
A	*			*	*			*	Good
B		*		*		*		*	Good
C		*		*		*		*	Good
D		*		*		*		*	Good
E		*		*		*		*	Good

Discussion

Radiation monitoring is an important safety precaution in the practice of radiography. It does not in itself provide protection against ionizing radiations. Its main purpose is to measure radiation dose received by radiology personnel, which can indicate that radiation doses received are within permissible limits, verify that facilities for radiation protection are adequate and show that radiation protection techniques are acceptable[11]. In the present study, dose rate value was measured in µSv/hr at different locations within and around the X-ray rooms taken at four to five different points and these measured values were far above the background rate, Table (2, 3, 4, 5 and 6). The dose rate measured at the staff room was (16.4µSv/hr and 20 µSv/hr) which are again far above the background radiation dose rate. This high dose rate could mean a higher health risk to the unsuspecting supportive personnel such as (doctors, radiographic, medical physics, hospital attendants and the visitors) **.** Such dose rate at the reception (0.4-20) µSv/hr could pose more serious problem to a pregnant personnel who is expected to have a dose limit of 2 mSv to the surface of her abdomen (the fetus). Recommendation of the International regulatory body stipulates that pregnant radiation workers should not work in areas where there is a risk of getting more than 30% of the allowed whole body limits for radiation workers. In addition, pregnant personnel should not be allowed to work in fluoroscopy, theatre radiography, mobile X-ray

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units or interventional radiography[12,13]. Results from table 7 indicate that the door that leads to the X-ray room was not efficiently lead lined; this inadequacy could have lead to the high dose rate at the reception and patient waiting area. The results also show that the cubicle is not efficiently lead lined. Interlock was not provided for the door and the door could not close automatically during the exposure to prevent intruders. It is necessary to note that controlled access to areas where radiation exposure may be taking place is required. It is also evident from table 7 that hazards warning light and personnel monitoring (TLD badges) were not provided in the majority of departments. In addition, qualified radiographer was not available and log books for keeping records of radiation protection activities in the unit were not available. The lead apron required to be worn by the radiographer during exposure was visibly missing. It therefore implies that in the X-ray unit of the hospitals, the issue of safety of personnel and patients are not adequately taken into consideration. This trend is an indication that the principle of as low as reasonably achievable (ALARA) principle was not adopted in the hospital[14]. As noted from the results, the quality control tests were outside the acceptable limit. This inconsistent nature specially for kvp could have adverse effect on the image contrast and leads to repeated exposure of the patient. Since the length of exposure affects the total quantity of radiation (mAs) emitted from an X-ray tube, an accurate exposure timer is essential for good radiographic imaging. The quality control tests for CT-Scan should be at least every three months, the results of quality assurance passed examination because our protocol was good. Patient doses for the same examination are known to vary widely between countries and even between hospitals in the same country, so estimates of national mean doses based on just local or foreign data will not be fairly reliable[13].In this study we have undertaken the quality control test and environmental monitoring of the facilities of X-ray unit for the hospitals. The quality control test obtained fall short of the required standard of International Commission on Radiological Protection (ICRP) and National Council on Radiation Protection (NCRP). In addition, facilities for the safety of both the public and personnel were grossly inadequate. Based on the indications of these findings and the follow-up studies, general overhauling of the facilities has since commenced. First, recommended safety and radiation monitoring materials have been put in place; second, new X-ray machine has been ordered. Many private hospitals did not agree to test radiation monitoring for their X-Ray department, we hope that they change their ideas about radiation safety.

Conclusion

Radiation protection measures in the radiological departments of Erbil hospitals are in a poor state thereby exposing the radiologists, paramedics, visitors and personnel at the hospitals to high radiation doses with the risk of future radiation hazard.

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