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Assessment of Radiation Protection Level among Patients at North of West Bank-Palestine

M. Aljamal[1*], A. Ayed[1,2] and W. Shawahneh[3]

[1]Department of Medical Imaging, Arab American University, Jenin, Palestine

[2]Department of Nursing, Arab American University, Jenin, Palestine

[3]Department of Medical Imaging, Jenin Governmental Hospital, Jenin, Palestine

[*]Corresponding e-mail: mohammad.aljamal@aaup.edu

ABSTRACT

This study was conducted to evaluate the radiation protection level among the examined patient in the diagnostic imaging department at different hospitals and centres at North West Bank of Palestine. The data were collected from fifty-nine (59) radiographers during the examination a total of 177 patients to check the practice of application of radiation protection among patients examined. A questionnaire that includes questions concerning radiation protection practices, procedures of imaging and methods of dose reduction to the patient's applications was used. The results showed statically that the radiographers showed a good understanding of the issues concern to radiation protection in terms of choosing appropriate exposure factors, the beam collimation, positioning of the patient correctly, and a low number of repeated films or exams only. On the other hand, the main issue that needs to be investigated with high concerns that the radiographer never used radiation protection tools such as lead apron among all patients examined even if the same patient was examined many times. In conclusion, the survey results revealed that there is an infringement in terms of radiation safety of the patient who examined in different medical imaging centres in Jenin city and the authorized organization in Palestine must take responsibility by taking an action to prevent these transcendences to assure the patients were protected properly from unnecessary radiation during diagnostic X-ray examination.

Keywords: Radiation protection, Radiation safety, Patient protection, Exposure factors

INTRODUCTION

X-ray uses in the medical field have been developed rapidly during the last years, where the majority of clinical decisions become highly influenced by medical radiation examinations [1,2]. Therefore, the risks of ionizing radiation are undeniable [3]. The hazard linked with ionizing radiation has been seen within a year of the discovery of X-rays such as skin burns after exposure to radiation dose. And within 7 years a case of skin cancer was observed, in all cases associated with high radiation dose exposure [4]. Based on a study conducted in the United Kingdom, it concluded that the harmful effects of medical radiation exposures could reach 100-250 death per year [5]. Ionizing radiation can bring high benefits to the human population when used in the medical field, but as ionizing radiation is associated with risks due to stochastic and deterministic effects, it is necessary to consider the protection of patients from potential harm [6]. Unnecessary radiation exposure of patients from medical procedures can lead to unnecessary risks due to stochastic effects. Unplanned exposure of patients can happen from unsafe use of medical technology which could lead to deterministic effects. The development of health effects caused by ionizing radiation starts with the physical processes of energy absorption in biological tissue, which lead to ionization with molecular changes which may occur in clusters, e.g. in the genetic information of cells, the DNA in the cell nucleus [4]. The effects on the human body of exposure to ionizing radiations depend upon the radiation dose received, the volume of tissue irradiated, and the sensitivity of the organs irradiated. The dosimetric quantities adopted by the commission are based therefore on measures of the energy imparted to organs and tissues of the body. They can be related to quantitative estimates of health risks. The relationship between radiation exposures and health effects is complex [7].

Radiation protection of patients means protecting the patient from unnecessary exposures [6]. According to the

IAEA, the overall facts and principles of radiation protection of patients are insurance that the benefits of medical exposure outweigh the risks. Communication with the patient and assurance to the patient to get radiation exposure is not more than necessary and at this level of radiation exposure, the risks are much smaller than the benefits [8]. Attention increased from both health professionals and the public to the inappropriateness of a substantial percentage of diagnostic imaging procedures [6]. For this reason, different organizations such as the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and The International Atomic Energy Agency (IAEA) have issued numerous radiation protection guidelines to assure the safety of using the medical radiation for whose working in the medical radiation field and the public as well [9-11]. During a diagnostic X-ray procedure, a holistic approach to patient care is essential. The patient care must begin with effective communication between the radiographer and the patient to reduce the probability of repeating the X-ray examination. Other tools and techniques that the radiographer must use to minimize the patient radiation dose during diagnostic X-ray procedures such as: using the immobilization system, protective shielding, selecting the appropriate technical exposure factor, and insuring correct radiographic positioning of the patient [8].

This study aims to evaluate the radiation protection level among the examined patient in the diagnostic imaging department at different hospitals and centres in north Palestine especially Jenin city, which is an important tool to make sure that the medical imaging departments are applying international regulations that concern protection of the patient from unnecessary radiation exposure.

METHODS

This study was conducted in four diagnostic imaging departments in north Palestine. This study was approved by the ministry of health for the investigators to utilize Khaleel Suleiman governmental hospital and the administration of Al-Razi private hospital, Alamal private hospital; and Khalaf centre. These hospitals provide medical care for all ages and traumatic patients. The data were collected during an examination of a total of 177 patients with different diagnostic imaging examinations. A total of 59 radiographers were included in this study, to investigate their practice in radiation protection of patients during these examinations. The questioner was filled by the researcher who has very good experience in the medical imaging field and the process of medical imaging examinations for the patients was also observed by the researcher. The questionnaire was revised and validated by a panel of 5 experts in the academic and radiological field. Internal consistency estimate was using Cronbach's alpha. The initial findings with an average of 0.90 which is strongly reliable. A pilot study was used to test the instrument. A pilot study was conducted with 10 patients from Khaleel Suleiman governmental hospital to determine the effectiveness of questions, completeness of response sets, time required to complete the questionnaire, and success of the data collection technique. The researchers determined that it would take fifteen minutes to complete each questionnaire. The study consisted of questions regarding patients' information with three items: gender, types of X-ray examination, and type of X-ray protection used. Radiographer information with three items: gender, educational level, and years of experience. Patient protection in diagnostic X-ray with nine items had Yes/No selection. Scoring system: 1 score was allocated to each Yes answer and 2 to the No answer.

The quantitative data were entered and analyzed using the SPSS (Statistical Package for Social Sciences version 20), and the level of significance (α) was set at 0.05. Demographic and baseline variables were analyzed using frequency and percentage. The hypothesis was tested and analyzed by using a one-way Anova test.

RESULTS

General Characteristics of the Subjects

The sample consists of 177 patients, 54.7% of the examined patient were less than 35 years old, the kids under 14 years old were 25.4% of the sample. The gender of the patients were 87 (49.2%) females, and 90 (50.8%) males (Table 1).

Table 1 Assessment of gender and age of the studied sample

Parameters		Number	%
Patient gender	Female	87	49.2
	Male	90	50.8
Patient age	1 month-14 years	45	25.4
	15-35 years	52	29.37
	36-64	69	39
	65 years and over	11	8

Hypothesis Testing

Table 2 revealed that a highly statistically significant relation between type of X-ray examination, gender of the patient, type of hospital, Gender of a radiographer, and years of experience and total mean scores of radiation protection (f=4.010 (0.004), 13.353 (0.001), 7.238 (0.002), 14.164 (0.000), 11.377 (0.001)), respectively. Also, it was revealed that no statistically significant relationship among total mean scores of radiation protection and education level of radiographer (f=3.803 (0.056)).

The highest number of X-ray examinations achieved in X-ray departments were chest X-rays (32%) while only 8.5% of patients had the lower extremity X-ray examination. The majority of the X-ray examinations were obtained from Khaleel Suleiman governmental hospital.

Most of the radiographers were male (84.7%) while the rest of the radiographers were female (15.3%). The radiographer in practice for less than 5 years were (50.8%) and (49.2%) for more than 5 years. The education level of the radiographers in this study revealed that 44 (74.6%) were holding a Bachelor's degree, and 15 (25.4%) were holding a Diploma degree (Table 2).

Table 2 Relationship between the mean of total scores of radiation protection and type of X-ray examination, gender of the patient, type of hospital, gender of the radiographer, education level of the radiographer, and years of experience

Assessment of the baseline characteristics of the studied sample (n=177)					
Parameters		**No. %**	**Mean**	**F**	**Sig.**
Patient gender	Female	87 (49.2)	1.3289	13.353	0.001
	Male	90 (50.8)	1.4205		
Type of X- Ray projection	Skull	39 (22.0)	1.3669	4.01	0.004
	Chest	57 (32.2)	1.3927		
	Abdomen and pelvis	18 (10.2)	1.3718		
	Upper extremity	24 (13.6)	1.2885		
	Lower extremity	15 (8.5)	1.3077		
	Vertebral column	24 (13.6)	1.4808		
Type of hospital	Governmental	69 (39.0)	1.398	7.238	0.002
	Private	57 (32.2)	1.3077		
	Centre	51 (28.8)	1.4208		
Distribution of the demographic features of the radiographers (n=59)					
Parameters		**No. (%)**	**Mean**	**F**	**Sig.**
Gender of radiographer	Female	9 (15.3)	1.265	14.164	0
	Male	50 (84.7)	1.3954		

Education level of radiographer	Bachelor	44 (74.6)	1.3601	3.803	0.056
	Diploma (2 years)	15 (25.4)	1.4205		
Years of experience	Less than 5 years	30 (50.8)	1.3333	11.377	0.001
	5-14 years	29 (49.2)	1.4191		

Table 3 showed that 47 (79.7%) of the radiographers give the patients the needed instruction, 57 (96.6%) of the radiographer placed the patient in the correct position. On the other hand, 49 (83.1%) of the radiographer choose the correct size of cassette, and 44 (74.6%) didn't use a marker. 48 (81.4%) of the needed immobilization was used. All of the radiographers were not used the proper shielding for the patients 59 (100%) while, 34 (57.6%) the radiographer consider the ALARA concept in choosing the exposure factors. 33 (55.9%) of the region of interest (body part) were well collimated and 53 (89.8%) the film processed well and only 11 (18.6%) of the radiographs were repeated.

Table 3 Assessment of radiation protection level of the patient during medical imaging examinations (n=59)

No.	Item	Yes		No	
		No.	%	No.	%
1	Did the radiographer give the patient the needed instruction?	47	79.7	12	20.3
2	Did the radiographic place the patient in the right radiographic positioning based on standard procedures?	57	96.6	6	3.4
3	Did the radiographer choose the correct cassette size?	49	83.1	10	16.9
4	Did the radiographer use the lead marker to locate the structure that need to be examined to exclude the repeating?	15	25.4	44	74.6
5	The immobilization system was used?	48	81.4	11	18.6
6	Did the radiographer place the proper X-ray shielding for the patient?	0	0	177	100
7	In choosing the exposure factors, did the radiographer consider ALARA concept?	34	57.6	25	42.4
8	Was the region of interest (body part) well collimated?	33	55.9	26	44.1
9	Was the X-ray projection repeated?	11	18.6	48	81.4

DISCUSSION

The use of ionizing radiation for diagnosis has many advantages over other methods such as physical examination and nowadays the majority of diseases especially cancer diseases can be diagnosed using diagnostic X-ray. However, this technique is associated with some risks such as damaging the living tissues after exposure to ionizing radiation [12,13]. The risk from ionizing radiation can be reduced using the proper protection tools and methods [14].

Radiographers in north Palestine showed a good understanding of the issues concern to radiation protection in terms of choosing appropriate exposure factors, beam collimation, positioning the patient correctly and a lower number of repeated films. where each factor has a dramatic effect on radiation exposure absorbed by the patient, for example, choosing the proper exposure factor could decrease the patient dose very high also, using collimation system can reduce the scattered radiation that could be spread away from the region of interest and therefore decrease the patient dose. Besides, placing the patient in the correct position could reduce the possibility to repeat the X-ray projection [14].

In terms of the education level of a radiographer, it is noted that had no significant effect on the scores, as one would have expected that the more educated radiographers should be able to apply the recommendation of ICRP on radiation protection standards during X-ray examination more than who is holding diploma degree. While the years of experience showed a significant effect on applying the proper method to protect the patients from unnecessary radiation. Unfortunately, while lead aprons were available in all the hospitals included in the study, no radiographer in hospitals or centres has used the lead aprons to protect the patient during X-ray examinations. The most important issue that has been seen during the X-ray examination and must be considered for the investigation is that the shielding

was not used even for children patients. Therefore, it can be assumed that the children patient in north Palestine might undoubtedly have received unnecessary radiation exposure. Since no radiographer used radiation protection tools among all patients examined, for whatever reason, if the patient has been examined many times using X-ray without protection could increase the chances to produce a stochastic effect. A possible explanation of this attitude showed by radiographers in all medical imaging centres could be attributed to since there is no radiation safety officer responsible for radiation protection in all hospitals and centres. There are no regulations in Palestine to assign a person to be responsible to take supervision of radiation protection practices in medical imaging departments, therefore there are no regulations in terms of monitoring the infringement that happens in medical imaging centres and there is no apprehension of possible sanctions among radiographers who does not consider the radiation safety standards during X-ray examination.

CONCLUSION

According to the results, all the techniques of radiation protection were applied, in acceptable values, except the most important part which is the shielding, which means that holistic radiation protection care is not enough. Therefore, some of the steps that must be taken seriously to assure that the patient's north of the west bank especially in Jenin city was examined safely using diagnostic X-ray such as the radiographers must take training courses related to the updated information about hazards of radiation and the techniques of protection and their efficiency. The ministry of health and all the organization in the west bank must take an action by making a regulation related to radiation protection in private and government medical imaging centres to assure that the patients are safely examined using diagnostic radiation and a sanction among radiographers must be taken for who does not consider these regulations.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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