«Original Articles »

The protection knowledge and performance of Radiographers in some hospitals of Ahvaz County

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Abstract

Background: Diagnostic radiology is the process of obtaining a high-quality image while minimizing the doses received by patients. Radiographers' knowledge of protection and safety principles and their correct application plays a significant role in radiation protection. Hence, this study aims to evaluate the radiographers' protection and safety knowledge, attitude and practice in the radiology wards at several hospitals in Ahvaz County.

Materials and Methods: This study is a descriptive and cross-sectional one conducted using an *observation* checklist and a scientific questionnaire, respectively by the researcher and radiographers to evaluate the protection and safety practice and knowledge of radiographers in some selected hospitals in Ahvaz County. The collected data were analyzed, using the SPSS version 20, through descriptive statistics, independent t-test, Pearson correlation test and analysis of variance.

Results: A significant correlation exists between radiographers' educational level and their protection and safety knowledge and practice. The results shows a significant difference between the protection and safety knowledge among radiographers in the selected hospitals as well as in their attitude and practice. It was also revealed that there exist a shortage of lead apron (29%) and a low level of its use even when available; the gonad and thyroid shield and lead partition for mobile radiology were not used at all.

Conclusion: The present study confirms the need to highlight protection and safety principles in the departments of radiology to ensure the safety of radiographers and patients.
In this regard, supplying protection equipment and holding courses on radiation protection are useful.

Keywords: Ionizing radiation, protection knowledge, radiographers

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Introduction

Ionizing radiation can cause serious effects on the hematopoietic system, digestive system, skin, testicles, ovaries, central nervous system, and ultimately, the entire body (1). Overexposure to ionizing radiation is a significant factor causing biological diseases such as various cancers, lens opacity, erythema, and genetic mutations (2). Epidemiological evidences indicate an increased risk of cancer resulting from exposure to X-rays (3, 4). Factors such as disproportionate radiation field, long periods of radiation, close range of radiation source to the body, and avoiding use of lead shielding increase the patients' radiation dose. Therefore, using their knowledge of protection, radiographers can minimize absorption of radiation in patients, while maintaining the diagnostic value of the radiographic image (5). Proper use of personal protective equipment and observing the instructions and regulations for protection against ionizing radiation can greatly reduce unnecessary exposure. Therefore, radiographers' knowledge of such standards and observances can play an important role in protection against radiation (6). The present study was thus carried out to assess radiographers' knowledge of and performance on protection against ionizing radiation in the radiology wards at some of the hospitals in Ahvaz County in 2013.

Previous studies show that proper staff training in the radiology ward in techniques of radiation and focusing, and employing trained and certified staff can reduce patients' radiation dose while affording desirable radiographic images (5,6). Wecare and Cameron pointed out that except for chest radiography certified technologists produced a marked decrease in patients' exposure (7). In a study to investigate the degree of observance of radiation protection principles in radiology wards in Bushehr Province in 2002, Tamjidi found that none of the principles of protection against radiation were fully observed, which might have resulted from radiographers poor performance , lack of proper staff training, or shortage of facilities and financial resources (8). Similarly, Amirzadeh and Tabatabaie's (2006) study, aiming at examining awareness of the principles of radiation protection among radiographers in the hospitals in Shiraz County, indicated an unsatisfactory level of awareness, with an exception in utilizing film badges (1). Thus it is imperative to investigate radiographers' knowledge and performance on protections against ionizing radiation, and hence promoting safety procedures, and likewise, to determine factors which lead to an increased absorption dose. The reliability of the questionnaire was measured and confirmed with a Cronbach's alpha of 87%. To measure radiographers' protection performance, we used an observational checklist designed according to the protection principles recommended by the International Commission on Radiological Protection ICRP), published by the Radiation Protection Division of the Atomic Energy Organization of Iran (AEOI), Steven B. Dowd's book entitled "Practical Radiation Protection and Applied Radiobiology", as well as related articles. The observational checklist contained 15 yes/no questions in regards to the observance of protection and safety guidelines, and was provided by the researchers. The population under study comprised all 86 radiographers in the selected hospitals. Seventy-one subjects completed the questionnaire, and their protection performance was also assessed. To collect the data, and without the radiographers' knowledge, the researchers visited the radiology wards and observed and recorded the performance of all personnel during morning, evening, and night shifts. The questionnaires on protection knowledge were given to every

staff member and were completed under the supervision of the researchers. Data were analyzed using the SPSS 20, through descriptive statistics, and analytical statistics, including independent t-test, Pearson's correlation test and one-way variance (ANOVA), and the significance level of p-value was set at 0.05.

Materials and Methods

This is a descriptive, cross-sectional study aiming to examine radiographers' knowledge of and performance on protection against ionizing radiation in the radiology wards in seven hospitals selected in Ahvaz County in 2013. Data on radiographers' protection knowledge were gathered using a researcher-made questionnaire of 10 questions, the face and content validity of which isconfirmed by a group of experts.

Results

The studied radiographers included 35 females and 36 males, between 21 and 53 years of age, with an average age of 29. Thirty-three held an associate's degree and 38, a bachelor's; 54 of the staff were contract workers and 17, official employees. Table 1 shows the average number of correct answers to each question in the questionnaire.

A comparison of the means revealed a statistically significant difference between the protection and safety knowledge scores of the associate's and bachelor's degrees holders (p-value=0.0001), and likewise, between their protection performance (p-value=0.0001) (Table 2).

Statistical analyses showed no significant difference in the mean scores of protection knowledge (p-value=0. 60) and the mean scores of protection performance (p-value=0.14) between male and female participants (Table3).

The one-way variance indicated a statistically significant difference between the protection knowledge scores of official and contract employed radiographers (p-value=0.01); however, no significant difference was seen between the protection performance of the two groups (p-value=0. 23) (Table 4).

Furthermore, the protection performance of the staff in the selected hospitals working morning, evening, and night shifts, analyzed through a one-way variance, did not show any statistically significant difference (p-value=0.66) (Table 5).

The results indicated a low level of lead aprons use for patients and those accompanying them (29%), a lack of use of gonad and thyroid shielding for patients, as well as lead screens during portable radiography (Figure 1).

Table1. Percentage of correct answers to questions on protection and safety knowledge among the radiographers in the selected hospitals in Ahvaz

		Percentage of correct answers		
	Questions	Associate's	Bachelor's	Total
1	What is the ALARA Principle?	30.3	44.7	38
2	How will radiation magnitude change if the distance is doubled?	66.7	71.1	69
3	What is the most effective way to reduce exposure?	54.5	76.3	66.2
4	How much lead should be applied to protect the exposed parts of the body of a person touching a patient?	39.4	63.2	52.1
5	What is the dose reduction factor in thyroid shielding?	57.6	68.4	63.4
6	Where should the film badge be worn?	39.4	76.3	59.2
7	What is the patient's absorbed dose in case of a PA lung radiography?	42.4	71.1	57.7
8	What is MAXIMUM PERMISSIBLE DOSE (MPD) of cumulative radiation for the whole body of a 30-year-old radiographer?	27.3	63.2	46.5
9	What is the best decision in reagrds with a pregnant radiographer?	48.5	73.7	62
10	What is the Rad's *10-25 rule*?	45.5	57.9	52.1
11	Total average	45.15	66.57	56.61

Table2. Comparison of protection knowledge and performance means by educational level

	Academic degree	Mean score	p-value
Protection knowledge*	Bachelor's	6.65±1.99	0.0001
	Associate's	4.51±1.92	
Protection performance**	Bachelor's	10.07±1.93	0.0001
	Associate's	7.28±2.31	

*Scores out of 10
**Scores out of 15

Table3. Comparison of the protection knowledge and performance means by gender

	Gender	Mean score	p-value
Protection knowledge*	Male	5.52±2.44	0.60
	Female	5.80±1.99	
Protection performance**	Male	8.95±2.55	0.14
	Female	8.28±2.50	

*Scores out of 10
**Scores out of 15

Table4. Comparison of the protection knowledge and performance means by employment type

	Employment type	Mean score	p-value
Protection knowledge	Official	6.76±2.63	0.01
	Contract	5.21±1.94	
Protection performance	Official	8.23±2.48	0.23
	Contract	8.96±2.55	

Table5. Comparison of protection performance means (out of 15) of the selected hospitals by work shift

Shift	Mean	Standard Deviation	p-value
Morning	8.86	2.39	0.66
Evening	8.71	2.57	
Night	8.36	2.73	

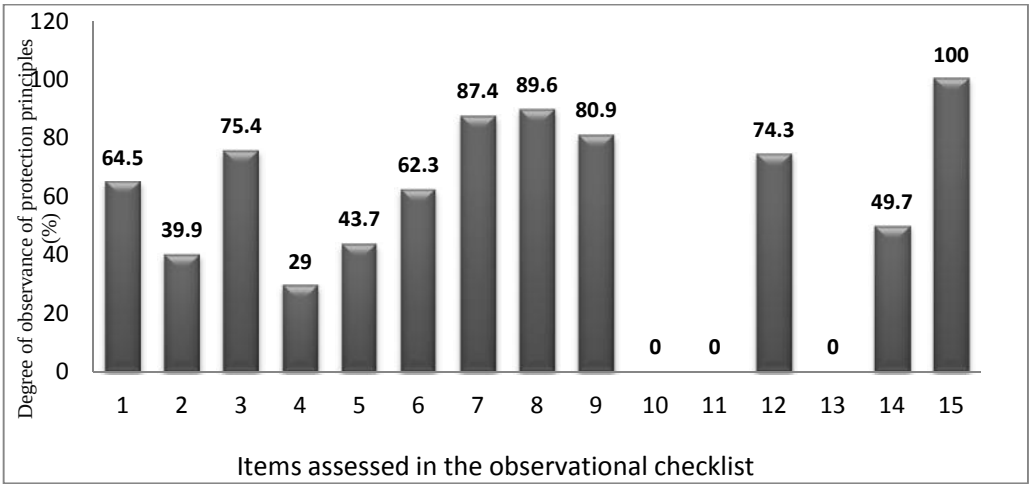

Figure 1. Degree of observance of each of the protection principles by the radiographers in the selected hospitals of Ahvaz

1. Observing the minimum distance between the patient and the tube
2. Not accompanying the patient during radiography
3. Keeping the door shut during radiography
4. Using a lead apron for the person accompanying the patient
5. Limiting the size of the radiation field to the object
6. Applying the inverse-square law of distance
7. Using the right mAs & kV
8. Removing the patient's metal possessions
9. Using a marker
10. Using gonad shielding for the patient
11. Using thyroid shielding for the patient
12. Using a film badge
13. Using a lead screen in portable radiography
14. Keeping the Cassette Pass's door shut during radiography
15. Checking the patient's identity against the relevant paper heading

Discussion

As mentioned in the results section, a statistically significant difference was observed in the protection knowledge and performance score means of radiographers with an associate's degree and those holding a bachelor's, indicating protection knowledge and performance improved as individuals' level of education was higher. This is in line with the findings of previous studies (1, 2, 4, 6) on the relationship between educational level and protection and safety knowledge and performance of radiology ward staff.

According to the ALARA (As Low As Reasonably Achievable) Principle, it is possible to considerably lower the dose of ionizing radiations during tests (7). The study results showed a mere 38% mean of correct answers to the question related to ALARA Principle, which is, nevertheless, a higher percentage versus the 12.3% reported by Rahimi *et al.* (5) in the Mazandaran province.

Even the slightest negligence in protection principles may increase the staff's exposure dose beyond standard levels. To determine whether this is the case, it is necessary to use a dosimetry film badge (8), usually worn over the chest or abdomen (9). The results indicated that only 74.3% of personnel were using these badges, highlighting the need for further supervision and emphasis.

Only 63.4% of the personnel were found to be aware of where to wear the film badges. Rahimi *et al.* (5) in the Mazandaran and Amirzadeh and Tabatabei (1) in the Shiraz reported a 26.3% and a 10% level of awareness, respectively. As recommended by the Atomic Energy Organization of Iran, the gonad area must be shielded whenever in a primary radiation field or very close to a primary radiation field (10). Shielding the gonad can significantly reduce the radiation dose, and, as absorption by the gonad typically constitutes 20% of the overall absorption dose of the body, these organs appear to be extremely sensitive to radiation, and prevention of the hereditary effects of ionizing radiation is not possible without protecting them. Therefore, gonad shielding must be routinely used in radiology labs (11). The present study revealed that gonad and thyroid shielding was never used for patients. As multiple authorities have investigated and clearly demonstrated the efficacy of protection equipment and the importance of shielding radiation-sensitive organs in reducing the absorbed dose (2, 13), a greater attention and emphasis in this regard seems necessary. According to Article 14, Section 4 of the Radiation Protection Law, passed in April 1989, failure to utilize designated protection equipment and ignoring protection and safety guidelines on the part of radiology staff is considered an offense, and the offender will be fined from 10,000 to 150,000 IR Rials, reminding which may enhance the observance of radiation protection by technologists (14).

Use of lead aprons creates an average of 75% to 80% protection of the red marrow (7). The study revealed that out of the 18 radiography rooms at the seven hospitals in the study, five were not equipped with lead aprons to protect patients and those accompanying them, and in the 13 rooms containing lead aprons, lead aprons were used only 29% of the time. The study conducted by Tamjidi in Bushehr, likewise, pointed out that out of the 25 radiology wards in the study, 23 did not use lead aprons for those accompanying the patient (8).

All radiology personnel must be trained on determining the conditions of radiation, and

required to use the radiation conditions table so as to avoid trial and error approaches (14). A study conducted by Saberi *et al.* in Ahvaz indicated that 42.8% of the damages to radiologic films were caused by incorrect selection of exposure factors which consequently results in the patient's increased exposure to radiation (15). The study showed that 87.4% of personnel used appropriate radiation conditions, which constituted a higher frequency versus the 61.5% reported by Borhani and Alizadeh (2) in Kerman.

For any kind of radiography, the size of the radiation field must be selected no larger than the size of the organ being photographed (14). Reducing the size of the radiation field from 8×10 to 6×6 in the spinal radiography results in a 50% decrease in the radiation dose. Limiting the size of the radiation field to the area of the organ being radiographed minimizes the patient's absorbed dose (16). The results of the current study revealed that radiation field limitation was observed in only 43.7% of the cases. The results of studies carried out by Borhani and Alizadeh (2) in Kerman, and Rahimi *et al.* in Mazandaran indicated corresponding figures of 38.5% and 46.4%, respectively.

The present study revealed that some radiographers are not dedicated to observing radiation protection and safety principles, possibly due to a lack of right attitude toward or belief in their acquired knowledge, or substandard or inadequate training. Limitations of the study include uncooperativeness on the part of some radiographers in filling out the questionnaires and a need to conduct the study on a larger scale. Considering the results and the significance of protection against ionizing radiation, holding more workshops, short-term training courses, preparation and distribution of posters and pamphlets on the effects of radiation on the body and protection and safety against ionizing radiation are recommended to raise staff and patients' knowledge and awareness levels. In addition, more inspection and supervision by health physics authorities seems in order.

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