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Radiobiology Knowledge Level of Radiologists

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Research Article

Abstract

Background: The effects of radiation on the biological systems of the human body are well known. It is critical for radiologists who are involved in the medical radiation field to have sufficient knowledge about biological effects of radiation such as cancer to avoid possible risks to patients and themselves. The aims of this study were to assess the knowledge level of radiologists about understanding the relationship between radiation dose level and possible biological effects, and to test whether experience and training courses can affect the knowledge level.

Methods and findings: A questionnaire was designed to cover most of radiobiology areas such as radiation induced cancer risk and radiation dose estimation sections, and radiologists from different departments of 4 major hospitals were asked to fill out the questionnaires. A total of 23 radiologists agreed to participate in the study. The mean total score of all sections was 59%. Among individual sections, the lowest mean score was for radiation induced cancer section (55%). Radiologists who carried out training courses scored higher than radiologists without training courses (61%, 54%, respectively). Experience (5.1 ± 0.9) did not correlate significantly with the questionnaire scores.

Conclusion: The radiobiology knowledge level can be improved by encouraging radiologists to attend more training courses specifically in the radiation induced cancer risk area and this may enhance overall understanding of the relationship between radiation dose and biological effects.

Keywords: Radiobiology; Cancer; Radiologists; Knowledge; Dose.

1. Introduction

Radiation and associated biological effects have been documented over decades. Ionizing radiation like computed tomography (CT) was associated with increased incidence of cancer [1-5]. CT scan is considered one of the most routinely used imaging modality. Accordingly, most cancer cases in the United States were linked to the CT examinations due to increased radiation dose. It was estimated that every 1000 scanned patients, there is one cancer incidence. However, cancer risk has been reported at high radiation dose level and its link with low dose level needs more evaluation [6-9]. Radiologists play an important role in the diagnosis process of patients. Their knowledge of radiation doses and associated biological effects is necessary in selecting the optimal diagnostic imaging test in terms of minimal required radiation dose and acceptable image quality [10,11]. The level of knowledge and understanding of radiation protection can be influenced by the radiologist license requirements. In Jordan, a radiologist is required to pass the Jordanian board of radiology after successful completion of radiology training in a recognized hospital. However, radiation safety training program attendance is optional. In comparison to other countries such as USA, radiation safety is a core exam in the American board of radiology [12]. Therefore, differences between countries can create variation in the knowledge level. In order to assess the knowledge level, several studies from different countries were conducted. A study was performed in Hong Kong and reported unsatisfactory knowledge level among radiologists and recommended a training on radiation associated risks [1]. Another study was conducted in 5 hospitals in London and found a lack of knowledge on radiation doses and risks [11]. Most of the studies reported lack of knowledge and insufficient understanding of radiation biological effects [13-20].

The aims of this study were to assess the knowledge level of radiologists about understanding the relationship between radiation dose level and possible biological effects, and to test whether experience and training courses can affect the knowledge level.

2. Methods

This study was approved by the institutional review board at Jordan University of Science and Technology. An expert radiographer distributed the questionnaire over 4 main local hospitals. Radiologists from all departments; including routine

x-ray imaging, angiography, CT, fluoroscopy, magnetic resonance imaging (MRI), ultrasound (US) and nuclear medicine (NM) were invited to participate in the study. After explaining the aims of the research and obtaining the consent forms, participants were asked to fill out the questionnaire. The questionnaire included demographic information section, general radiation protection section, radiation dose section, and radiation induced cancer risk section. Questions in general radiation protection section were selected to evaluate the general knowledge and the understanding of background radiation exposure in comparison to medical X-ray radiation exposure, ionizing and non-ionizing radiation types and radiosensitviy of children biological organs. Questions in radiation dose section were designed to assess the ability of radiation dose estimation of common radiological examination in comparison to the dose of one chest X-ray. Lifetime cancer risks of common radiological examination questions in the radiation induced cancer risk section were provided to evaluate the understanding of cancer risk from different radiation doses. This knowledge can improve the communication between radiologists and patients about explaining the radiation risks of radiological examinations. The questions were adopted from previous published questionnaires [7,14,20]. The questionnaire was available in Arabic and English versions.

For statistical analysis, two values were assigned for grading the answers; 1 for correct answer and 0 for incorrect answer. For each subject, total score of all sections (17 questions) and individual section scores were calculated as percentage (total correct answers divided by total number of questions). Then, mean scores and standard error (SE) were calculated. One-way ANOVA was used to test significant difference between individual section scores and Student's t-test was used to test significant difference between trained and untrained subject scores. The difference was considered significant if p-value was less than or equal to 0.05. Pearson's correlation coefficient was calculated to test the correlation between the experience and the questionnaire scores. Statistical analysis was performed using Prism 5 (GraphPad, La Jolla, CA, USA).

3. Results

A total of 23 radiologists agreed to participate in this study. Demographic information is summarized in Table 1. The mean total score of all sections was 59%. Among individual sections, the lowest mean score was for radiation induced cancer section (55%). However, there was no significant difference between scores (p=0.4). The questionnaire score results are summarized in Table 2. Radiologists who carried out training courses scored higher than radiologists without training courses (61%, 54%, respectively). Table 3 summarizes the results of trained and untrained subjects. Experience in years (5.1 ± 0.9) neither correlated significantly with the total score nor with the score of individual sections. Table 4 summarizes the correlation test results (Appendix).

Table 1. Summary of demographic information of participants.

Number of subjects	Male	Female
	19	4
Experience in years (mean ± standard error)	5.1* ± 0.9†	
Percentage of trained subjects	74%	
Percentage of untrained subjects	26%	

*Mean; † Standard error

Table 2. Summary of questionnaire scores.

Total score of all sections	General radiation protection section	Radiation dose section	Radiation induced cancer section	*P* valu
59.1%* ± 3.4%†	62.7%* ± 4.8%†	57.4%* ± 4.6%†	55.7%* ± 4.2%†	0.4

*Mean; † Standard error

Table 3. Summary of trained and untrained scores.

Score of trained subjects	Score of untrained subjects	*P* value
60.9%* ± 4.4%†	54%* ± 3.6%†	0.4

*Mean; † Standard error

4. Discussion

Radiobiology is an important area of science for radiologists who are engaged with medical examinations involving radiation exposure that can result in adverse biological effects to patients. In order to justify exposure of patient to radiation, they need to have an acceptable level of knowledge of radiation dose and biological effects. Accordingly,

Table 4. Summary of correlation test results between questionnaire scores and experience.

Variables	Correlation coefficient (r^2)	*P* value
Total score and experience	0.09	0.16
General radiation protection section score and experience	0.15	0.07
Radiation dose section score and experience	0.003	0.8
Radiation induced cancer section score and experience	0.03	0.4

this study aimed to test their knowledge level in different areas of this field including general radiation protection section, radiation dose estimation section and radiation induced cancer section.
The results indicated an overall inadequacy of knowledge (59%). The lowest obtained score (55%) was for radiation induced cancer section. This section measured the ability of radiologists to differentiate between imaging modalities that are associated with different level of radiation doses to induce cancer. Although trained radiologists scored higher than untrained radiologists, the difference was not significant. A study was conducted among cardiologists to examine their knowledge of radiation protection before and after training course [19]. An improvement of their score was recorded after attending the training. Experience did not show to have a significant improvement on the scores. This was similar to study conducted in U.S. academic medical center found that most of radiologists were unable to accurately estimate the dose for one CT scan compared with that for one chest radiograph regardless their experience level [13]. The results were similar to previous studies that tested the knowledge level among physicians and radiologists. A survey was conducted of the awareness of radiation dose and risk among health professionals in Northern Ireland [7]. Their results confirmed that clinician awareness of radiation doses and the consequent risk to the individual patient is poor. They recommended clinicians to have more education about ionizing radiation relevant to medical imaging.

This is the first study to report knowledge level of radiobiology among radiologists in Jordan. Although the sample size is not large enough, the results can establish a baseline for future studies to include more hospitals from private and governmental sectors.

5. Conclusion

Lack of radiobiology knowledge can impact the important role of radiologist in patient imaging justifications. Training courses are recommended to improve the knowledge of radiobiology among radiologists especially in the area of radiation induced caner. Future studies are recommended to engage physicians from different departments who are involved in referring patients to radiology department.

6. Acknowledgement

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8. Competing and Conflicting Interest

No competing interests exist.

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