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Assessment of Knowledge and Awareness towards Radiation among Medical Staff

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Abstract Radiation is widely used in the diagnosis and treatment of many diseases, but limited usage of radiation for medical purposes is important. When the human body is exposed to radiation doses over 1 Sievert, gastrointestinal, neurological and hematological disorders in the acute stage appear. Exposure to low doses of radiation over a long period of time may result in genetic effects such as cataract, cancer, shortage in lifespan, or transmitting of genetic disorders to future generations. Employees in these practices should be protected from radiation effectively and be provided with safety devices. The level of awareness concerning radiation protection influences the staff behavior. If they do not have, enough information related to radiation safety, their action will not be safe and will result in adverse effects. This questionnaire was designed and introduced to medical staff in Brack Hospital at Al-shatti region to evaluate their knowledge levels about ionizing radiation and their awareness about radiation safety. The statistical comparison between the groups was analyzed using the Statistical Package for the Social Sciences (SPSS) program. The results showed that they lack of knowledge and practices toward radiation safety related to radiological imaging and training programs are recommended.

Key word: Awareness, Brack Hospital, knowledge, Radiation, (SPSS).

1. Background

Radiation is defined as energy spread from a source in the form of waves and particles. Due to their professions, people are exposed to ionizing radiation in many fields, such as industry, medicine, education, research, atomic power plants, and fuel generation.[1] About 18% of exposure is due to man-made sources.[2] Medical use of radiation is the largest man-made source of radiation exposure. Radiation is used widely in the diagnosis and treatment of many diseases. In particular, radiation doses obtained during interventional radiology, computed tomography, mammography, and fluoroscopy examinations may reach high levels. X-ray is the most ionizing radiation that has been used in the hospitals and 30% to 50% of medical decisions are based on radiological examinations. However, it is still limited by its relevant hazards to patients and healthcare providers.[3-6] In developing nations, more recent studies show that about 3.6 billion imaging studies per year are carried out worldwide, leading to an increase of 70% in worldwide collective effective dose for medical diagnostic procedures.[7] Although all medical interventions have potential benefits, it's potential risk should not be ignored.[8] Since the doses of x-rays used for diagnostic purposes are small, it is generally considered that health risks to individuals are also small. However, the growing number of people exposed to x-ray radiation makes low level x-ray radiation dosing a more pressing concern.[9] Ionizing radiation may effects gastrointestinal system, central nervous system, gonad or even whole body. These effects may appear as somatic effects or in next generation as genetic effects. There is no threshold level of radiation exposure level which could assure that cancer or genetic effects will not occur. Doubling the radiation dose doubles the probability that a cancer or genetic effect would occur.[7] The potential risks of radiation comprises of stochastic effect of which probability increases with dose and deterministic effect of which severity increases with dose. Cancer induction and genetic effects are stochastic effects while cataracts, blood dyscrasias and impaired fertility are examples of deterministic effects.[8] Radiation safety is the protection of people and the environment against ionizing radiation beams. It is to provide protection against the harm of ionizing radiation in practices where radioactive substance and similar sources of radiation are used.[1] Therefore, before undertaking any radiological examination, it is important that the physician, radiologist and radiographer all be aware the potential risks of radiation and also its advantages or benefits to the patients.[8]

A key component of this initiative involves raising awareness of the risks medical imaging poses. However, patients' knowledge of the amount of they are exposed to from advanced medical imaging tests, as well as the downstream risks of radiation exposure, has only begun to be characterized.[10] This aim of this study is to evaluate the knowledge levels and awareness among medical staff in Brack Hospital at Al-shatti towards ionizing radiation and radiation safety.

2. Material and Methods:

A questionnaire survey was conducted between August and October 2017 of (37) employees (X-ray technician, Clinician, and others including: Nurses, Lab.-Technicians, and chemists) in Brack Hospital at Al-shatti. The survey consisted of close-ended questions regarding the awareness and the knowledge of the basic principles of radiation in diagnostics using ionizing radiation. The objective of the survey was to evaluate the knowledge of the medical staff regarding selected topics on the basic principles of radiation doses and radiation protection in diagnostics using ionizing radiation. The questionnaire was available in Arabic and English versions. Data were analyzed using statistical package for social sciences program (SPSS). The results are in tables and graphs.

3. Results and Discussion:

Demographic information is summarized in Table (1) and Figure (1)

Table 1: Distribution of participants according to personal and work characteristics (N = 37)

Age (year):	
Mean ± SD	33.16±6.24
Range	23 – 53
Sex:	
Male	16(43.2%)
Female	21(56.8%)
Job category:	
X-ray technician	6(16.2%)
Clinician	8(21.6%)
Others	23(62.2%)
Duration of work (year)	
Mean ± SD	8.16±5.40
Receiving radiation safety training (Yes)	7(18.9%)
Exposure frequency (/week):	
Less than one time /week	9(24.3%)
1 - 3 times/week	7(18.9%)
More than 3 times/week	8(5.4%)

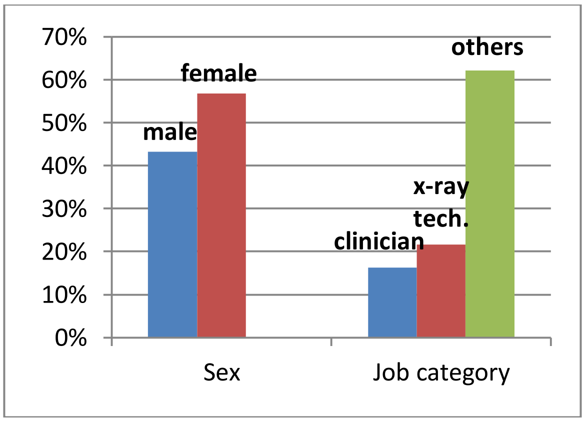

Figure (1) Distribution of participants according to sex and job category characteristics

Thirty-seven people participated in the study, 16 (43.2%) males and 21 (56.8%) females. Table (1) and Figure (1). Their ages ranged between 23 years and 53 years, Table (1). Only 7 (18.9%) of participants received radiation safety training. The mean working experience of the participants in this study was 8 years Table (1). Regarding exposure frequency, 7(18.9%) of participants reported more than three times exposure/week. The results of the questionnaire on radiation dose, occupation radiation exposure, and radiobiology sensitivity knowledge level are summarized in Table (2).

The highest percentage of correct answers was 15(40.5%) about the organs with the highest radiation sensitivity, whereas the others were 12(32.4%), 7(18.9%), and 9(24.3%), Table (2). The highest permitted level of occupational radiation exposure is 0.25 microSievert per hour (µSv/h) or 20 milisievert per year (mSv/y).[11] In some countries, the population dose from medical exposures now rivals that from natural background.[12]

In developed countries, irradiation from medical ionizing test results in a mean effective dose per year per head corresponds to about 150 chest x-rays, an amount comparable to that of one year of natural background radiation. This radiation exposure may elevate a person's lifetime risk of developing cancer.[3]

Table 2: Distribution of participants' knowledge regarding radiation dose (N = 37).

	No. (%) of correct answers
The radiation, in milli-Sieverts (mSV), is a person exposed to, on average, every year, from natural background radiation. (0.24 mSV- 2.4 mSV - 24 mSV - 240 mSV)	7(18.9%) <u>2.4mSV</u>
The highest permitted level of occupation radiation exposure. (0.2mSV - 2mSV - 20mSV - 200mSV)	9(24.3%) <u>20mSV</u>
The organs that have the highest radiation sensitivity. (Liver - Kidney- Thyroid - Bone Marrow)	15(40.5%) <u>Bone Marrow</u>
The imaging procedures that have the highest radiation exposure. (CT Head - Chest X-ray - Ultrasound -Abdominal X – ray)	12(32.4%) <u>CT Head</u>

CT comprises 4% of examinations. It makes a 40% contribution to the collective dose of radiation Ionizing radiation causing genetic damage, which is linked to cancer induction. But this varies depending on the duration and the dose of exposure. The average radiation dose received annually by the public is 2.5 mSv, and 15% of them are related to medical exposures. Among all radiological examinations, the doses of CT are the highest. The typical exposure dose for an abdominal CT is 9 mSv, and that for one chest radiograph is 0.02 mSv.[4] While CT assists with making faster, more accurate diagnoses, physicians have become increasingly aware of radiation exposure associated with it. This exposure carries the potential long-term risk of radiation-induced malignancies, particularly in children and young adults. Based on epidemiologic data, the radiation exposure of one abdomen pelvic CT, which is approximately 10mSv, confers an estimated 1:2000 risk of developing cancer.[10] When the human body is exposed to radiation doses over 1Sv, gastrointestinal, neurological, and hematological disorders in the acute stage appear. Or as a result of low dose exposure over a long time, genetic effects such as cataract, cancer, shortage in lifespan, or transmitting of genetic disorders to future generations may be observed.[1] The survey results of the dose (in equivalents to a single chest X-ray) received by a patient during some procedures are summarized in Table (3).

Table 3: The dose (in equivalents of a single chest X-ray)

Single Chest X-Ray Equivalents	No. (%) of correct answers
Plain abdominal radiography	4(10.81%)
Abdominal ultrasound scan	7(48.9%)
Abdominal and pelvic CT	3(8.1%)
Thyroid isotope scan	1(2.7%)
Head CT	9(24.3%)
Brain MRI	7(18.9%)

It is noticed that lack of the knowledge about the equivalent dose of radiation is equivalent to a single chest X-ray in diagnostics using ionizing radiation Table (3). The dose (in equivalent of a single chest X-ray) for different imaging procedures are illustrated in Table (4).

Table 4: Correct answers are marked X–estimated on the basis of European Commission guidelines [13]

Single chest X-ray equivalents	0	10-49	50-99	100-199	200-299	300-499	500-600
Plain abdominal radiography			X				
Extremity angiography						X	
Head CT					X		
Thoracic CT						X	
Abdominal and pelvic CT							X
Voiding cystourethrogram				X			
Abdominal ultrasound scan	X						
Thyroid isotope scan		X					
Brain MRI	X						

The results and distribution of participants regarding radiation protection are summarized in Table (5)

Table 5: Distribution of participants regarding radiation safety (N = 37)

	No. (%) of agree response
X-ray radiation doses used for diagnostic imaging examinations might increase the risk of patients developing cancer in future.	32(86.5%)
The three principles of radiation protection are clear and easy to understand.	17(45.9%)
Signs of radiation are clear and easy to understand.	17(45.9%)
The policies and procedures on radiation precautions are clear and easy to understand.	16(43.2%)

In Table (5), 32(86.5%) of responses agree that X-ray radiation doses used for diagnostic imaging examinations might increase the risk of developing cancer in future. 17(45.9%) agree to emphasis clear and easy to understand signs and principles of radiation protection. Only 16(43.2%) agree that the policies and procedures on radiation precautions are clear and easy to understand. Although x-ray radiation for medical imaging is clinically useful, it is estimated that 20% of medical x-ray examinations are not beneficial, and that these and other unnecessary exposures lead to 100-250 cases of cancer each year in the UK.[9] Approaches and risks regarding the protection against ionizing radiation are regularly followed by The United Nation Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and UNSCEAR continuously presents reports to the United Nations (UN) General Assembly. According to the International Commission on Radiological Protection (ICRP), which publishes scientific journals toward the protection against radiation, personal dose limits in beaming should be determined to for the protection of personnel. Determining personal dose limits is to limit the amount of dose that individuals may be exposed to as a result of beaming.[1] Reduction of exposure time, increasing distance from source, and shielding of patients and occupational workers have proven to be of great importance in protecting patients, personnel, and members of the public from the potential risks of radiation. These three radiation protection actions of "time-distance-shielding" are the triad of radiation protection. Radiation protection is a general term applied to the profession or science related to protect people and the environment from radiation hazards.[8] The safety of employees working with sources of ionizing radiation, other people around them, and the society at large should be provided. For that reason, it is very important that necessary measurements should be carried out, that radiation should be used in a controlled way, and that individuals working with radiation sources should be trained continuously.[1]

4. Conclusions:

Knowledge level toward radiation doses and radiation protection in diagnostics using ionizing radiation among the medical staff is poor. Training programs can significantly raise awareness and knowledge level in this field. Lack of knowledge among the staff can cause more occupational radiation exposure. This lack of awareness may cause more order to radiological investigations. A better knowledge of radiation protection issues becomes an important element of professional expertise of not only radiologists and radiation therapists, but also other specialists as well as medium level or auxiliary staff.

5. Acknowledgement:

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