KNOWLEDGE ABOUT IONISING AND NON-IONISING RADIATION AMONG MEDICAL STUDENTS

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Background: The majority of patients remain concerned about radiation exposure and the health risk associated to it. A doctor is a person who can answer all pertinent questions regarding radiation and can satisfy their patients. Medical students, who are future doctors, can acquire this capability during their clinical rotation in the radiology department. The study is to assess knowledge, hazards, misconceptions and misunderstanding among medical students regarding equipments using ionizing and non-ionizing radiation. **Methods:** A questionnaire was self administered to medical students of a private medical college of Karachi. One hundred and twelve students who had completed their clinical rotation in the radiology department from fourth and final year MBBS class were included in the study. The obtained data was analyzed using statistical software. **Results:** Nearly 40% of the students accepted that objects in the X-ray room emit radiation after an X-ray procedure and nearly the same percentage agreed that protective measures should be taken while performing an ultrasound and that dangerous radiation is emitted from good quality microwave equipment. Slightly more than one-third students viewed that gamma rays are more hazardous than X-rays while the same percentage agreed that intravenous contrast material used in angiogram is radioactive. Sixty-seven percent students agreed that nuclear material used in medicine is potentially explosive while 18% of students were in the opinion that MRI emits ionizing radiation. Twenty-eight percent of the students believe that a radiologist have a shorter life span as compared to other medical specialist. **Conclusion:** The majority of medical students in both years have limited knowledge about various aspects of radiation sources, the risk involved and its protection. Better teaching methods and programmes are required for medical students in the subject of radiology.

Key words: ionising radiation, medical students, radiology

INTRODUCTION

The term 'radiation' covers a wide spectrum of different forms of energy, most of which have been suspected to cause ill health to human-beings.[1] The effects of low-level exposure to ionizing radiation are of a concern to large number of people.[2] They are also concerned about health risk associated with it and their knowledge about radiation that influences their decision going through medical procedure along with the level of satisfaction with medical care provider. Cassels[3] had presented a general overview of some of the radiation myths among public and suggests ways to improve public understanding on radiation issues. Awareness among people by media on radiation risks is aggressive but often exaggerated.[4] This creates several misconception, confusion and erroneous beliefs that exist with regard to in-hospital radiation hazards. Studies have documented that most people overestimate the risk of industrial radiation and underestimate the risk of medial radiation application.[5,6] Similarly, in procedures involving contrast materials a large majority of individuals want some information before injecting contrast medium.[7]

It is one of the responsibilities of a health care professional to provide first hand knowledge to the patients undergoing all radiological procedures and processes. The physician can answer to queries of a common-man regarding radiation hazards, which can be reliable provided their knowledge is adequate and up-to-date. The knowledge related to radiation is taught during undergraduate training in medical colleges. However, physicians grossly underestimated the proper risk regarding proper use of medical imaging tools and their associated radiation risks.[8,9] Even among medical students, a survey showed an acceptable level of awareness of radiation protection.[10] Literature review has revealed that there is a lack of studies on aspects of radiation among medical students in Pakistan.

The curriculum for a medical student involves teaching various subjects that aims specifically at the application of knowledge and problem solving skills during in a pre-assigned academic period. In Pakistan, medical students underwent their clinical rotation in the department of radiology either in the fourth or in the final year of undergraduate training programme. Within the curriculum, the Pakistan Medical and Dental Council has combined six subjects that includes radiology and has allocated a total of 40 hours in five years.[11] Medical students acquire knowledge about the fundamentals of radiology and the interpretation of clinical radio-diagnostics during their rotation in the radiology department. If medical students are not empowered with sufficient and precise knowledge regarding different aspects of radiation, it would be difficult to communicate correct information to the potential radiation recipient.[12] This study provides an

indication of the level of knowledge among senior medical students for the risk involved in relation to potential health hazards associated with the radiological equipments and procedures.

The objectives of the study were to:

- assess the knowledge of ionizing and non-ionizing radiations and their hazards among medical students.
- identify the level of understanding regarding use of ionizing and non-ionizing equipments among medical students.

MATERIAL AND METHODS

A cross-sectional study was conducted in one of the private medical colleges of Karachi, Pakistan having a batch of minimum 100 students in each year of a five-year MBBS degree programme. A total of 217 medical students were enrolled in the two academic years (fourth and final). A semi-structured questionnaire based on a previously conducted study was developed regarding different aspects of ionizing and non-ionizing radiation.[13] Only those students who had completed their twenty-five days posting in the radiology department among the fourth and final years were included in the study. The questionnaire was self-administered to 57 and 60 students of the fourth and the final year medical students respectively. Five questionnaires with incomplete responses were rejected. The data obtained by the questionnaire was entered and were analyzed using statistical software SPSS version 11.0. Chi-square was used to test the level of significance between the two years of the study sample.

RESULTS

Table-1 shows responses given against eight questions by the respondents about various common aspects of ionizing and non-ionization radiation. Surprisingly, all responses except for one question, showed less than fifty percent correct answers by the students. A statistically significant difference was found between the fourth and final year students in three questions related to ionizing radiation whereas 58% percent of the both fourth and final year students thought that after a radiological examination procedure, objects in the room emit radiation. Only 5 (9%) students in fourth year admits that gamma radiation is not hazardous than X-rays and showed a statistically significance difference ($p< 0.0005$) than the final year students. A similar result was observed when only 7 (13%) fourth year students expected radiologist to live shorter than other medical specialists ($p<0.0005$). Forty-two (80%) of the fourth years students were more knowledgeable than 33 (55%) final year students as they knew that nuclear material used in medicine does not explode ($p=0.003$). Only 10 (19%) students of the fourth year and 12 (20%) final year students know that contrast material used in angiogram is non-radioactive. Similarly, 23 (44%) and 22 (36%) students of both fourth and final year students respectively were unaware of the fact that there is no risk involved in performing an ultrasound examination while 17 (33%) and 27 (45%) students in both years respectively considered that a good condition microwave does not emit harmful radiations. Barely 12 (23%) among the fourth year and 9 (15%) among the final year students recognize magnetic resonance imaging technique to be non-ionizing. All other responses related to non-ionizing radiation remained to be non-significant when fourth year was cross- tabulated with the final year students.

The mean differences between scores of fourth and final year students is illustrated in Table-2 and were found to be 3.44 for fourth year and 3.05 for the final year students. Student's *t*-test showed a statistically difference for fourth year students when compared to the final year students ($p<0.0001$).

Table-1: Questions about various aspects of ionizing and non-ionizing radiation

	Questions	Fourth year (n=52)	Final year (n=60)	Total (N=112)	Significance*
		Correct responses			
1.	After completion of an x-ray examination objects in the room emit radiation.	22 (42.3 %)	22 (36.6 %)	44 (39.2%)	N/S**
2.	Gamma rays hazardous than X-rays	5 (9.6 %)	24 (40 %)	29 (25.8%)	$p<0.0005$
3.	Nuclear material used in medicine potentially explosive	42 (80.7%)	33 (55%)	75 (66.9%)	$p<0.003$
4.	The life span of the radiologist is shorter than other medical specialist	7 (13.4%)	26 (43.3%)	31 (27.6%)	$p<0.0005$
5.	Intravenous contrast material used in Angiogram is radioactive	10 (19.2%)	12 (20%)	22 (19.6%)	N/S
6.	Use of protective measures by health care staff while performing ultrasound examination	23 (44.2%)	22 (36.6%)	45 (40.1%)	N/S
7.	Good condition microwave emits dangerous radiation	17 (32.6%)	27 (45%)	44 (39.2%)	N/S
8.	Magnetic resonance imaging (MRI) emits ionizing radiation	12 (23%)	9 (15%)	21 (18.7%)	N/S

* Chi-square as a test of significance, ** N/S = Not significant

Table-2: Comparison of total marks of fourth and final year students

Students	N	T	Mean Difference	Significance*
Fourth year	52	22.729	3.44	$P< 0.0001$
Final year	60	16.241	3.05	$p< 0.0001$

* Students'*t*-test as test of significance

DISCUSSION

Everyone alive in this world is being exposed to ionizing radiations and about 18% exposure is due to man-made source.[14] There is likely to be a risk in investigations that involves ionizing radiation to patient's health as the US National Council on Radiation Protection and Measurements had reported that medical X-rays and nuclear medicine accounts for only 15% of all exposures to radiation.[15] Similarly, in the United Kingdom, an estimated 100–250 deaths occur each year from cancers directly related to medical exposure to radiation.[16] Although the use of radiation technology has led to vast improvements in the diagnosis and treatment of patients, there are adverse effects that depend on the type and the intensity of radiation involved while some risk is generally acceptable.[17] The effects of low level exposure to ionizing radiation are of concern to a large number of people including workers receiving radiation exposure on job.[18-20] While various studies had documented deficiencies in knowledge among medical students, doctors, para-medics and dentists about either understanding of ionizing radiation or the use of equipment involved.[9,10,21] The results of this study was found to be analogous to a Dutch study involving medical students that showed insufficient knowledge about radiation hazards of in-hospital procedures; the majority of the students believed that objects emit radiation after a radiological procedure.[13] The present study clearly demonstrates significant difference between the mean scores of fourth and final year regarding ionizing and non ionizing radiation and of the equipment used which may influence their decisions for using the equipment as well as informing patients about the exposure, dose and health risk associated to any imaging procedure. Although magnetic resonance imaging (MRI) and ultrasound, after taking appropriate precautions do not pose a radiation hazard and can be safely used, there is less doubt in radiation risk associated with medical imaging techniques including bone scans.[8] Furthermore, there is no health risk to medical or emergency personnel treating patients exposed to high levels of radiation, subjected to proper universal precautions.[22]

The deficiency in knowledge of a health professional might alter the expected benefits, compared to the risk involved, and can effect medical decisions. Therefore, this study emphasizes the need for all health providers to equip themselves with the current and appropriate knowledge about ionizing and non-ionizing radiation. Along with providing objective facts, they must also address the emotional needs of patients.[5] Appropriate educational efforts combined with effective communication skills resolve errors in judgment that are linked to inadequate or inaccurate information, thus leads to better healthcare outcomes.[23] Explaining implications of radiation should be considered vital for every professional, along with efforts to maximize basic radiation protection.[24] Health care providers should also understand the physics, chemistry and biology of radiation in order to effectively communicate about it.[14] And to any question inquired by patients, an adequate response should be given. Moreover, for developing knowledge among students about radiation hazards and prevention, an effective medical education model would be helpful to disseminate information to those who have limited knowledge about radiology and radio-diagnostics.[8]

CONCLUSION

Patient education about radiation and its effects should be part of responsibilities of health care providers. This study concludes that the majority of medical students have limited knowledge about radiation sources, risks and its protection. Misconceptions about exposure risk were present among medical students that could potentially affect health care decisions. Delivering specific objectives regarding radiation in the curriculum as well as during radiology ward rotation for medical students are required, that can modify behaviours regarding health beliefs and attitudes prevalent within the communities. Further studies are required to highlight the importance of radiation harm and its protection.

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Non-ionizing radiation lacks the energy to break these same molecular bonds. But there is more to this answerÂ Non-ionizing radiation can also be quite powerful, and does have the power to alter the position of atoms in their orbit, but lacks the energy to completely displace, or ionize, them. Take a look at the chart below to get a good visual of the different types of electronics that emit ionizing and non-ionzing radiation. Examples of Ionizing Radiation. Natural sources of Ionizing RadiationÂ Man made examples of Ionizing Radiation: Medical testing equipment such as x-rays, radiotherapy, and tomography. Nuclear Reactors. Examples of Non-Ionizing Radiation. Natural sources of Non-Ionizing Radiation: Sunlight. Fire. Overall medical studentsâ€™ knowledge of radiation dose and the risks associated with ionising imaging examinations was reported to be low. Main messages. â€¢ Medical studentsâ€™ knowledge about radiation and associated risk is poor. â€¢ Students are not aware of radiation doses for common radiological procedures. â€¢ The majority of students underestimated radiation doses for specific examinations. â€¢ Students with confidence reported greater knowledge than students with no confidence. Introduction. The number of medical imaging examinations that use ionising radiation in Norway is increasing. Ionizing radiation is a form of energy that acts by removing electrons from atoms and molecules of materials that include air, water, and living tissue. Ionizing radiation can travel unseen and pass through these materials. For more information on ionizing radiation, click here. What is non-ionizing radiation?Â The dividing line between ionizing and non-ionizing radiation occurs in the ultraviolet part of the electromagnetic spectrum [shown in the illustration of the electromagnetic spectrum above]. Radiation in the ultraviolet band and at lower energies (to the left of ultraviolet) is called non-ionizing radiation, while at the higher energies to the right of the ultraviolet band is called ionizing radiation. For more information on ionizing radiation, click here. Institute of Medicine. 1995. Environmental Medicine: Integrating a Missing Element into Medical Education.Â Radiation may be of two types, ionizing or nonionizing (Figure 1). Ionizing radiation is capable of physically disrupting neutral atoms by dislodging orbital electrons, thus forming an ion pair consisting of the dislodged electron and the residual atom. Ion pairs are chemically reactive and may produce toxic agents in the cell (e.g., free radicals from water), which can interfere with normal life processes.