ORIGINAL ARTICLE

# Knowledge of medical students on hazards of ionizing radiation.

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## ABSTRACT

***Background:*** *The use of the ionizing radiation in the medical practice has evolved since its beginnings. Their benefit for the patient is considerable in term of comfort, diagnostic and therapeutic effectiveness. It is estimated that 30% to 50% of critical decisions in medical approaches is based on x-ray examination. Using the X-ray as a diagnostic means by clinicians requires appropriate and accurate knowledge about its advantages and negative biologic effects.*
***Purpose:*** *to evaluate the knowledge of medical students in clinical courses in Birjand University of Medical Sciences on ionizing radiation hazards.*
***Methods:*** *In this cross-sectional study, knowledge of medical students (in clinical courses) on 3 categories ( of basic principles of radiobiology, radiation protection and practical issues in radiation protection) assessed by a 20-item questionnaire which its reliability and validity had been well established. chi-square and independent-t tests were employed to analyze data gathered via these questionnaires.*
***Results:*** *Total number of medical students involved in this study was 100. Mean knowledge score was 9.07+/-2.1 (for clerkship students, p <0.05) and 10.13+/-2.73 (for interns p <0.05).*
*Of clerkship students 51.4% and of interns 25.4% obtained good scores (p<0.03) in the radiobiology. But in the other categories (radiation protection and practical aspects of radiation protection) no group achieved good scores.*
***Conclusion:*** *The results indicate that despite the importance of radiation and its consequent hazards, knowledge of medical students is not adequate. It is suggested that the content relevant to radiation and radioactive hazards in medical curricula should be revised, including quantitative and qualitative aspects of the subject. A reasonable step to more effective education regarding radiation and relevant issues is to integrate safety practices in clinical courses.*
***Keywords:*** *KNOWLEDGE, MEDICAL STUDENT, IONIZING RADIATION, HAZARDS*

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## Introduction

The use of the ionizing radiation in the medical practice has evolved since its beginning. Their benefit for the patient is considerable in terms of comfort, diagnostic and therapeutic effectiveness.

Radiotherapy is one of the most effective treatments implied for palliative or curative treatments and is effective as well as surgery in patients suffering from certain type of cancers.

At present X-ray imaging is one of the routine and developing methods and it is estimated that 30% to 50% of critical decisions in medical approaches is affected by x-ray examination (1).

In addition, diagnostic and therapeutic effects of short half-life radionuclides have been confirmed during past three decades and led to development of nuclear medicine.

Increasing the awareness of the hazards associated with ionizing radiation and its consequent disorders and diseases requires more attention as a part of a comprehensive radiation safety program.

Using the X-ray as a diagnostic means by clinicians requires appropriate and accurate knowledge about its advantages and negative biologic effects. Warnings regarding the excessive use of these radiations and instructions proposed for safe application of these technologies are mostly based on the recommendations of The National Council on Radiation Protection and Measurements (NCRP) and The International Commission on Radiological Protection (ICRP) (2,3).

Careful use of X-ray for diagnostic purposes should be accompanied with appropriate

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knowledge and attitude of its advantages and

ray disadvantages, theoretical and practical aspects of radiation protection can help to imply imaging with x-ray efficiently and properly. In Limburger state University, Netherlands, Janssen and Wellness showed that several misunderstandings, misconceptions, and erroneous beliefs exist regarding in-hospital radiation hazards. The authors conclude that it is unlikely that ignorance about this subject be restricted to Dutch medical students (4).

Sometimes interns avoid accompanying patients that need medical supports during imaging procedures; pregnant female interns avoid walking through radiology wards and medical students are afraid of being in radiological control rooms (overestimation of radiation hazards)(5,6). In contrast, insisting on high-risk diagnostic procedures instead of simple and less dangerous ones and unnecessary radiographic imagings for patients with multiple traumas are examples of underestimation of radiation hazards in medical settings. This study was carried out to assess the awareness of medical students passing the internship and clerkship courses on hazards of ionizing radiations and radiation protection.

## Material and Methods

This cross-sectional study was conducted on 100 medical students (37 in internship and 63 in clerkship courses) of Birjand University of medical sciences. A 20-item questionnaire was developed according to most recent up-date references. Validity of this questionnaire was confirmed by 3 professors of radiology and reliability was determined by calculating

alpha = 0.72).

Questionnaire items were categorized in 3 groups: basic principles of radiobiology (5 items), radiation protection (8 items), and practical issues in radiation protection (7 items). There was one positive point for each correct answer and a zero point for each wrong answer. Therefore, according to the number of items, there were a minimum score equal to 0 and a maximum overall score equal to 20. Scores less than 50% of 20 score were considered as poor, between 50% and 75% medium and greater than 75% were considered as good scores. Chi-square and independent-t tests were employed to analyze data gathered via these questionnaires.

## Results

100 medical students (63 interns and 37 clerkship students) filled out the questionnaire. Forty-one students (41%) were female and 59 were male (59%). Overall mean score was 9.5±2.4 (for interns: 9.07±2.1 and for clerkship students: 10.13±2.73,$p<0.05$ ). There was no significant difference between females and males in scores, but mean score in the category of practical aspects of radiation protection was significantly greater in female students in comparison with males students (2.46±0.86 in female students and 1.94±1.94 in male students). In radiobiology category, 51.4% of interns and 25.4% of the clerkship students had good scores and knowledge of other students was poor or medium ($p<0.03$). But in the category of radiobiology ,none of the students had good score, but 19% of interns and 40.5% of clerkship students had medium scores ($p<0.02$) and other scores were poor.

The same results were seen in the category of practical aspects of radiation protection; only 27% of clerkship students and 37.8% of interns, obtained medium scores and others had poor scores and none of the students obtained good scores. There was no significant difference between clerkship students and interns in scores. Table 1 shows the percents of the scores obtained by the students in each item and also shows scores obtained by each one of two study groups (clerkship students and interns) separately.

## Discussion

The results of the current study demonstrate that despite the importance of radiation and its consequent hazards and that responsible

Organizations of Iran (AEOI), guidelines regarding dose reduction and optimizing the use of radioactive agents, knowledge of medical students is not adequate (in medium range of 9.5±2.2, $p<0.05$). This finding is in line with the reports of Janssen and Wellness that showed in Limburger State University, medical students' knowledge is poor on radiation hazards (4). Regarding knowledge of radiobiology, more than half of the interns and more than 25% of the

**TABLE 1** Comparison between relative and absolute frequency of awareness level in medical students (clerkship and internship courses).

| Category | Item | Sex | | | | Level of significance |
|---|---|---|---|---|---|---|
| | | Male | | Female | | |
| | | F | P | F | P | |
| Radiation protection | Which one of the mentioned radiation sources affected normal population more than others?<br>1) Natural radiating resources 2) Medical procedures<br>3) Industrial resources 4) Internal resources | 25 | 42.4 | 11 | 26.8 | 0.11 |
| | Which one of the mentioned organs is more important to be protected against radiation in head and neck radiography?<br>1) Esophagus 2) Thyroid gland 3) Spinal cord and brain<br>4) Hypophise gland | 49 | 83.1 | 35 | 85.4 | 0.75 |
| | Which one is 10-days rule of WHO about radiation protection in women in gestational ages?<br>1) Only in first 10 days after the begining of menstural period radiologic studies is allowed<br>2) Only in first 10 days after the cessation of menstural period radiologic studies is allowed<br>3) Only in first 10 days after the begining of menstural period radiologic studies is forbidden<br>4) Only in first 10 days after the cessation of menstural period radiologic studies is forbidden | 36 | 61 | 29 | 70.7 | 0.31 |
| | protection against ionizing radiation?<br>1) Walls 2) Floor 3) Ceiling 4) All items | 16 | 27.1 | 13 | 31.7 | 0.62 |
| | istance from the X-<br>skin? 1) 60 cm 2) 40 cm 3) 80 cm 4) 90 cm | 18 | 30.5 | 14 | 34.1 | 0.7 |
| | 1) Rad 2)Roentgen 3)Gray 4) Sievert. | 19 | 32.2 | 10 | 24.4 | 0.3 |
| | Which one of mentioned situations is associated with the lower risk for life shortening?<br>1) Smoking one packet of cigarette daily 2) Car accident<br>3) Working in a radiological setting 4) 12 Kg overweight | 16 | 27.1 | 23 | 56.1 | 0.00 |
| | Which one of the following organs can be exposed with greater maximum permissible dose of radiation?<br>1) Temporal bone 2) Skin<br>3) Pallmar region 4) Pulmonary parenchyma | 22 | 37.3 | 5 | 36.6 | .92 |
| Practical aspect of radition protection | Which one of these diagnostic procedures is associated with greater dose of radiation?<br>1) Barium enema 2) CT scan 3) Chest X-ray 4) Skull X-ray | 26 | 44.1 | 14 | 34.1 | 0.32 |
| | Which test is associated with more radiation absorption in patients?<br>1) Momography 2) CT scan 3) Chest CT scan 4) Chest MRI | 18 | 30.5 | 15 | 36.6 | 0.52 |
| | One of the patients in orthopedics ward needs X-ray imaging. Responsible intern ask to accompany the patient while imaging with a that should be considered in this case?<br>1) There is no need to such precaution 2)1 meter<br>3) 2 meter 4) 10 meter | 22 | 37.3 | 22 | 53.7 | 0.10 |
| | Patient is a woman with a 16 weeks fetus. Sonography has revealed hydronephrosis in left kidney and there is some RBC in U/A. Which one is the next step in diagnosis?<br>1) IVP 2) MRI 3) CT scan 4) Sonography | 25 | 42.4 | 19 | 46.3 | 0.7 |
| | Which one increases radiation absorption in a KUB imaging?<br>1) Using IV contrast-media 2) Valsalva maneuver<br>3) Using oral contrast-media 4) Using green sensitive X-ray film | 14 | 23.7 | 16 | 39 | 0.10 |
| | for a 45 year-old woman?<br>2) Smoking one packet of cigarette each day for 1.5 months<br>3) KUB and Chest X-ray graphies<br>4) Standing and supine KUB X-ray graphies | 19 | 22.2 | 8 | 19.5 | 0.2 |
| | Which radiography is associated with the minimum radiation reached to gonads without any protection during imaging?<br>1) Lateral lumbo-sasral view X-ray 2) Water's view sinus X-ray<br>3) Dosal-pllantar view X-ray 4) Chest X-ray | 33 | 55.9 | 33 | 80.5 | 0.01 |

(Table 1. continued)

| Category | Item | Sex | | | | Level of significance |
|---|---|---|---|---|---|---|
| | | Male | | Female | | |
| | | F | P | F | P | |
| Principles of radiobiology | Which one is the most sensitive tissue in the case of radiation? 1) Thyroid 2) Muscles 3) Brain 4) Skin | 49 | 83.1 | 39 | 95.1 | 0.06 |
| | Which one is the most resistant tissue to ionizing radiation? 1) Epithelium 2) Chondrocytes 3) Epithelial cells 4) Neurons | 27 | 45.8 | 16 | .9 | 0.50 |
| | Which cell generation is the most sensitive when exposed to radiation (rank the items according the level of sensitivity)? 1) Blood-forming stem cells-reproductive cells-epithermal stem cells 2) Reproductive cells-epithermal stem cells- Blood-forming stem cells 3) Reproductive cells- Blood-forming stem cells-epithermal stem cells 4) Blood-forming stem cells- epithermal stem cells- reproductive cells | 29 | 49.2 | 23 | 56.1 | 0.5 |
| | Which is the most common neoplasm followed by radiation? 1) Leukemia 2) Lymphoma 3) BCC(skin) 4) Seminoma | 37 | 62.7 | 12 | 29.3 | 0.00 |
| | 1) Few increasing in temperature 2) Ionizing 3) Cavity formation 4) Changing the pressure of b | 43 | 72.9 | 37 | 90.2 | 0.03 |

clerkship students obtained good scores and there

scores. But concerning basic principles of radiobiology, knowledge of medical students was rated poor or medium and none of them obtained good scores.

Better scores obtained by the students in radiobiology may imply that the curricular content covering radiation in the basic science and general courses (medical physics course) is adequate. Poor knowledge scores in radiation protection and practical aspects of radiation protection may reflect inadequate coverage of the subject in the curriculum.

Thus, measures to improve knowledge, attitude and skills of the medical student regarding radiation hazards and protective measures that should be taken are highly recommended.

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