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Assessment of the Effect of Clinical Rotation in Radiology on Medical Students' Awareness Level of Ionising Radiation and Radiation Protection

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Abstract. Doctors' knowledge of ionising radiation and radiation protection is vital, especially when requesting radiological investigations that involve patient's exposure. A cross-sectional study conducted during the academic year 2009-2010 at Faculty of Medicine, King Abdulaziz University. The objective was to evaluate the effect of clinical rotation in radiology on medical students' awareness of ionising radiation. A questionnaire was used to collect data from 326 of 6th year medical students post clinical rotation. Fourth year students were used as a control, representing students with no theoretical or clinical experience in radiology. One hundred sixty-three students (50%) scored around 60%, 13 (4%) scored zero and only 22 (7%) scored 85% or above. However, 6th year students scored higher than the control group in most questions with an overall mean ± SD of 51.6±19.7. Nearly 38% thought that objects in the room still emit radiation after completion of exposure. More than 50% of them thought that magnetic resonance imaging involves ionizing radiation. The results highlighted; students who completed their clinical rotation in radiology performed better than those who did not; over-all knowledge of ionising radiation and radiation protection is still very poor. Modification to the existing curriculum should be considered.

Keywords: Ionising radiation, Radiation safety, Medical students, and Radiology curriculum.

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Introduction

X-rays were discovered in 1895 and since then it played a great role in the advancement of medical sciences and health care[1]. With these advancements, concerns with regards to ionizing radiation dose to patients during radiological investigations or treatments are rising. The relationship between the risk of cancer and radiation exposure was shown from studies done on the Japan bomb survivors and the Chernobyl survivors[2]. It has been reported that for every 100 mSv a patient is exposed to, their "cancer death risk increases to 25.5% from a background risk of 25%"[3], and this risk increases inversely with age. On the other hand, the media has played a huge role in exaggerating the risks associated with ionising radiation[1,3]. It is assumed that doctors have obtained the proper education and training to know the exact dose associated with each radiological investigation he/she requests for their patients. They should be able to overweigh the risk and benefit of these investigations to justify patients' exposure to ionising radiation.

Extensive literature revealed that since 1989 and up to date, there is a growing concern about the knowledge of the referring doctors when it comes to ionising radiation and radiation protection. Some of these have shown that although doctors are aware of the side effects associated with each medicine they prescribe, they lack the adequate knowledge to provide correct information to their patients with regards to radiation and exposure doses[1,3,4-8].

In addition, several studies suggested that this lack of knowledge is due to inadequate information on ionising radiation, and radiation protection in the undergraduate medical curriculum and clinical training[6-10]. Consequently, this gap in knowledge among newly graduates from medical colleges could reflect on the judgment of radiation dose associated with all types of radiological procedures and their unjustified requests.

Furthermore, King Abdulaziz City for Science and Technology (KACST) is the national body for authorisation of use and practice of ionising radiation within the Kingdom of Saudi Arabia. They set regulations for all users and prescribers of ionizing radiation. As a result, a flag is raised with regards to justification and optimisation of radiation doses to patients for both, diagnostic and therapeutic radiology. In order

to follow these regulations, sufficient knowledge about ionising radiation is required[11].

In that respect, the knowledge level was previously assessed of fourth year undergraduate students at the Faculty of Medicine (FOM) - King Abdulaziz University (KAU) before and after a dedicated lecture on ionising radiation and radiation protection[9]. The effect the lecture had on their knowledge was studied and found that correction of misconceptions was possible.

The literature showed the lack of knowledge of ionising radiation and radiation protection in the medical school's curriculum, and therefore, this study aims to evaluate the effect of the clinical rotations in the Department of Radiology at King Abdulaziz University Hospital (KAUH) on medical students' awareness of ionising radiation.

Materials and Method

The present cross-sectional study was conducted during the academic year 2009-2010 at the FOM-KAU, Jeddah, Saudi Arabia. A self-administered structured questionnaire was used to collect data from sixth year undergraduate students after completion of their clinical rotation in the Department of Radiology. Participation in this study was optional. Ethics approval was granted from the Biomedical Ethics Research Committee at KAU.

Instrument

A previously published and validated questionnaire was used to collect data for this study[9]. The questionnaire consisted of 7 questions on general knowledge of ionizing radiation and basic principles of radiation protection (Appendix 1). In addition, it tested students' knowledge about diagnostic procedures such as CT and magnetic resonance imaging (MRI).

Subjects

The study subjects consist of 6th year (final year) undergraduates at FOM-KAU who completed the questionnaire at the end of their clinical rotation in the Department of Radiology at KAUH. These students received a total of 8 hours of didactic lectures, and 15 hours of tutorial for radiological case discussions and imaging analysis. Students who did not provide a completed questionnaire were excluded from the study.

The Control

Fourth year undergraduate students at KAU before attending any lectures in radiology, imaging, and radiation protection, were asked to answer the same questionnaire. They represent students with no theoretical or clinical experience in radiology and radiation protection. They served as the control for this study.

Statistical Analysis

The data was entered and analyzed using Statistical package for social science (SPSS version 19, SPSS Inc, Chicago, Il, USA). The "student's" *t*-test was used to study correlation between variables. Statistical significance was considered at p-value less than 0.05. Correct answers to each question were given one mark each, while the incorrect ones, or omissions, received a mark of zero. A total score was given to each student out of 7.

Results

Out of the 447 sixth-year medical students at KAU in 2010, 326 (73%) chose to participate in this study and represented the main study population. Among those were 122 (37%) and 204 (63%) female and male students, respectively. One hundred sixty-three students (50%) scored around 60%, which is considered the passing grade. Thirteen students (4%) got all their answers wrong and scored zero. Only 22 students (7%) scored around 85% or above.

The control group consisted of 333 students from fourth year. One hundred seventy three (52%) were female and 160 (48%) were male. This group was used as a control as they had no exposure to clinical rotation.

Table 1 demonstrates the overall mean score for both groups. Sixth year students scored higher than the control group with a mean ± SD of 51.6 ± 19.7. They have also scored higher in all questionnaire statements, except for questions 5 and 6 (Table 2). In addition, there were statistically significant differences in knowledge between both groups in all questions, except for question 6 ($p = 0.21$).

On the other hand, differences between male and female students' scores were observed (Fig. 1). Male students scored higher than the female students in most questions (5 out of 7) and the average scores

were 53% and 49%, respectively. Of the thirteen students who scored zero on the questionnaire, 9 were female (69%). In addition, only 8 female students (36%) scored 85 % or above, compared to 14 male students (64%).

Table 1. Descriptive Statistics.

Year		Mean ± SD	95% Confidence Interval
4th year		38.7 ± 23.9	36.12 - 41.27
6th year		51.6 ± 19.7	49.48 - 53.77

SD= Standard Deviation

Table 2. Correct answers on each of the 7 questions.

Questions	4th Year Students N (%)	6th Year Students N (%)	P-value
1	176 (53)	202 (62)	0.02*
2	80 (24)	137 (42)	0.00*
3	170 (51)	225 (69)	0.00*
4	153 (46)	245 (75)	0.00*
5	37 (11)	13 (4)	0.01*
6	203 (61)	183 (56)	0.21
7	83 (25)	173 (53)	0.00*

*N= number of students with correct answers; * indicated a statistical significant difference.*

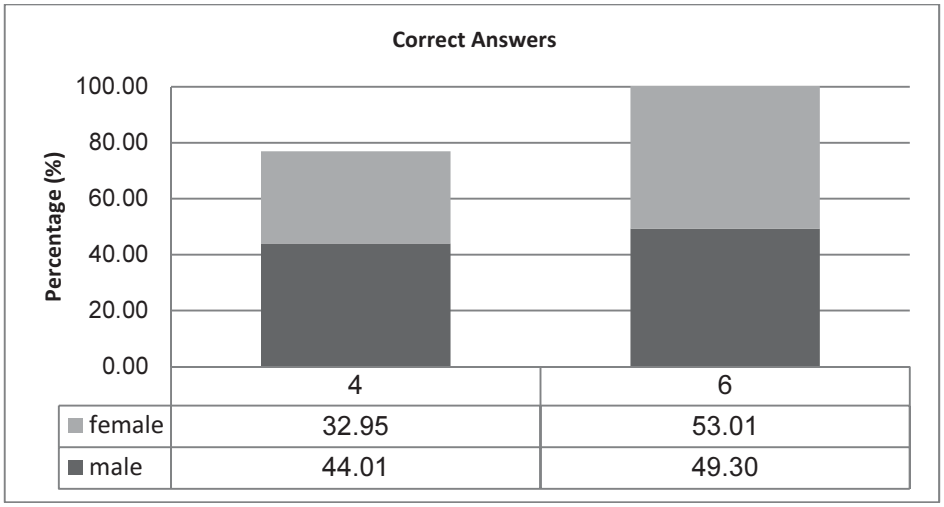

Fig. 1. Data represents overall percentage of correct answers for both male and female students among the two groups.

In general, nearly 38% of the students thought that objects in the room would still emit radiation after completion of the exposure. Only

42% knew that intravenous contrast material used in angiograms in not radioactive. Twenty-five percent of the students underestimated the computed tomography (CT) exposure dose. Furthermore, more than 50% of the students thought that MRI involves ionizing radiation.

Discussion

Radiology is a dynamic branch of medicine and although advancement in technology leads to better health care, the underestimation of exposure doses and the misconception of doctors could be hazardous to patients and their families. There is a risk of cancer development from extensive exposure to ionising radiation from radiological investigations. In Australia, the Lancet reported a rise of around 430 new cases of cancer as a result of diagnostic investigations every year[12]. Furthermore, it is believed that up to a third of all requested radiological studies are completely or partially unnecessary. It is the responsibility of referring doctors to assess the risks and benefit of any radiological investigation, or procedure in the management of their patients. The 'as low as reasonably achievable' principle should always applied. Medical curricula must include enough lectures and proper training in ionising radiation and radiation protection. Any deficiency could result in underestimation of the risks of imaging-related radiation, leading to unnecessary exposure[6,8,10,13].

The aim for this study is to evaluate the knowledge of medical students at KAU and assess the effect of the clinical rotation in radiology on their knowledge. The results of our study coincide with what Mubeen *et al.* reported in 2008[10]. After completing their clinical rotation in radiology, students still believed that objects in the x-ray room emit radiation after completion of exposure, (38%) this result is similar to the one reported by Mubeen *et al.*[10] (40%). They also underestimated exposure dose from CT, (25%). Also more than 50% of the students thought that MRI scans involved ionizing radiation, while in Mubeen *et al.* study only 18% thought that MRI involves ionizing radiation.

This study demonstrated the deficiency in knowledge of medical students with regards to medical imaging, ionising radiation and radiation protection. Only 47% of the sample population scored 60% or above, passing grade. Although the scores of the students who completed clinical rotations were higher in 5 out of 7 questions, their over-all

knowledge of radiation protection is very poor and there is an obvious gap in their learning.

Sixth year students scored higher in questions 1, 2, 3, 4, and 7 which were relevant clinically. On the other hand, fourth-year students were better in question 5 and 6, which were related to basic science previously covered in first year medical physics curriculum, and can be avoided in the radiology rotation since both the nuclear medicine and MRI areas are considered optional. Performance of male students on the questionnaire was better than that of female students, but this difference is not statistically significant ($p = 0.262$).

The findings of this study are limited by the fact that no data was collected before the clinical rotation in the Department of Radiology. Having such data would have reflected on the exact knowledge gained from these four weeks.

Conclusion

Despite the fact that students who completed their clinical rotation in radiology performed better than those who did not, their over-all knowledge of ionising radiation and radiation protection is still very poor. Modifications to the existing curriculum should be considered. Current graduates have several misconceptions and lack of vital knowledge that should have been picked up during their undergraduate years in the topics of ionising radiation and radiation protection that can be alarming[6-9].

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Appendix 1

Dear Student,

By completing this questionnaire and submitting it to your professors, you are agreeing to participate in a study that will tell us a lot about missing information in your learning path to become better doctors.

No	Questions
1	After completion of an x-ray examination, objects in the room emit radiation: a) True b) False
2	Intravenous contrast material used in angiogram is radioactive: a) True b) False
3	Which of the following organs is more important to be protected against radiation in head and neck radiography: a) Esophagus b) Skin tissue c) Spinal cord and brain d) Thyroid gland
4	Which of these following procedures is associated with greater dose of radiation: a) Barium enema b) CT scan c) Chest X-ray d) Skull X-ray
5	The SI unit for measuring radioactivity is: a) Sv b) Rad c) Gy d) Bq
6	An MRI of the spine of 45 min length is equivalent to: a) 25 Chest X-ray b) 15 Chest X-ray c) 5 Chest X-ray d) 0 Chest X-ray
7	Gamma ray is more hazardous than X-ray: a) True b) False

Thank you for participating.

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تقييم مدى تأثير التدريبات السريرية في قسم الأشعة على مستوى وعي طلبة كلية الطب عن الإشعاعات المؤينة والحماية من الإشعاع

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المستخلص. مدى معرفة الأطباء عن الإشعاع المؤين أمر هام عند طلب القيام بتشخيص إشعاعي يتضمن تعرض المريض للأشعة. أجريت دراسة في كلية الطب بجامعة الملك عبدالعزيز خلال العام الدراسي ٢٠٠٩/٢٠١٠م لتقييم تأثير التدريس السريري في قسم الأشعة على معلومات ووعي طلاب السنة السادسة بأضرار الإشعاع المؤين. تم استخدام استبيان لجمع بيانات ٣٢٦ من طلاب السنة السادسة بعد الانتهاء من فترة التدريس السريري واستخدم طلاب السنة الرابعة للمقارنة، يمثلون الجزء من العينة الذين ليس لديهم خبرة نظرية أوسريرية في الأشعة. النتائج أظهرت أن ١٦٣ طالبًا حصلوا على٦٠٪، ١٣ (٤٪) حصلوا على صفر، و ٢٢ (٧٪) حصلوا على ٨٥٪ أو أكثر. حصل طلاب السنة السادسة على نتائج أفضل من السنة الرابعة في معظم الأسئلة ٥١,٦ ± ١٩,٧. أثبتت الدراسة أن ٣٨٪ من الطلاب يعتقدون أن غرفة الأشعة تبقى مشعة بعد الانتهاء من التصوير. كما يعتقد أكثر من ٥٠٪ منهم أن التصوير بالرنين المغناطيسي (MRI) يحتوي على أشعة مؤينة. وضّحت النتائج أنه بالرغم من أن الطلاب الذين أكملوا فترة التدريس السريري في الأشعة

حصلوا على نتائج أعلى من المجموعة الثانية إلا أن معلومات كليهما في الأشعة المؤينة والحماية منها لا يزال ضعيفًا. وينبغي النظر في تعديل المناهج الحالية للحد من التعرض للأشعة غير الضرورية بالنسبة للمرضى.