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Iranian physicians' knowledge about radiation dose, received by patients in diagnostic radiology

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Background: Although ionizing radiation is widely used to diagnose many diseases, the relevant hazards are known to be as an important limitation of its application. It is believed that the awareness of ionizing radiation dose values is one of the main stages in patient's radiation protection. The purpose of this study has been to investigate the level of physicians' knowledge about radiation doses received by patients in radiological examinations. ***Materials and Methods:*** A questionnaire was designed and the most commonly requested radiological investigations were listed. Participants (155 physicians) were asked to identify the average dose of radiation received by patients when they underwent a posterior-anterior hand X-ray. Then, it was utilized to represent a single dose of radiation, and physicians were asked to estimate the equivalent doses of radiation for other radiological examinations. Several questions were also included about dose measurement's units and low exposure risk investigations. ***Results:*** The results indicated that only 58.3% of physicians know the units of radiation absorb dose measurement units. Most of them could not correctly estimate the amount of radiation dose received by patients in a routine radiography of hand and majority of them underestimated the radiation dose of other radiological examinations. ***Conclusion:*** Despite of passing medical physics course, during studentship, it does seem that most of medical doctors did not have enough knowledge about the amount of radiation received by patients led for diagnostic radiology investigations.
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INTRODUCTION

The average radiation dose annually received by general public is 2.5mSv, and 15% of them are related to medical exposures [1, 2]. The use of radiation in medical practices has evolved since its beginning and 30% to 50% of medical decisions are based on radiological examinations [3], however, the hazards of ionizing radiation are irrefutable. For instance, according to recent studies in United Kingdom, 100-250 death per year occurred because of harmful effects of medical radiation exposures [1, 4]. Reducing the patients received dose As Low As Reasonably Achievable (ALARA) is based on the recommendations of all radiation protection organizations such as International Commission on Radiation Protection (ICRP) and National Radiological Protection Board (NRPB) [1-4].

Awareness of medical practitioners about hazards of ionizing radiation is reported to be one of the main factors for decreasing the patients' dose in medical practices [2, 4]. The studies indicate that the improvement of medical doctors' information about radiation dose received by patients in different diagnostic imaging procedures. The hazards of radiation led, therefore, help them to optimize the radiological examination prescriptions [3, 4]. The first step of radiation protection can be started by ordering the radiological investigations [3, 4]. If doctors are aware of radiation dose

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received by patients in different radiological investigations, they will avoid unnecessary examinations and prescribe counterpart examinations with low or without radiation risk [3-5].

Increasing medical doctors' knowledge of radiation hazards is a part of radiation protection programs [5]. It seems necessary to instruct the doctors and radiographers along with special consideration about radiation dose delivered in different imaging modalities. For correct estimation of patients received dose in different radiologic examinations, one can be referred to the results of radiation doses surveyed by NRPB reported in 1980's [6, 7]. The current study focused on medical doctors' knowledge about the radiation dose received by the patients who were prescribed for radiological examinations. Also, their awareness of radiobiology was evaluated.

MATERIALS AND METHODS

A cross- sectional questionnaire-based study was conducted since October 2007 to April 2008. In order to conduct the study, a list of common requested radiological investigations was prepared at the first stage. The correct values of radiation dose received by patients in different investigations were obtained from average values reported in literature [1, 2, 4, 6, 8-15]. In addition, United Nation Scientific Committee on the Effects of Atomic Radiation (UNSCER) report details for radiation doses of radiological examinations in different countries was used as the main reference; of course, there was no advanced data about Iran [16]. Regarding dose values variation which was received by patients in different studies, a 20% deviation of dose values was applied.

The above mentioned questionnaire consisted 5 main categories. First, the audience were asked about radiation dose measurement units. The second question was about the amount of radiation dose received by patients in a posterior-anterior plain radiography of hand (hand-PA). The Annual Maximum Permissible Dose (AMPD) in common public and the most sensitive organ to the radiation made the third and fourth ones. Finally, the last category consisted of several questions about estimation of patients received dose in commonly requested radiological exams. In those questions, the dose received by patients in a plain radiography of hand (hand-PA) was assumed as the reference unit and the practitioners were then asked to estimate the dose delivered by other examinations proportional to plain radiography of hand.

155 questionnaires were given to 155 physicians including 98 general physicians (GPs) and 57 specialist physicians (SPs). However, only 120 doctors, 86 general physicians and 34 specialist physicians (consisted of urologists, dermatologists, pediatricians, neurologists, orthopedists, ophthalmologists and ear, nose and throat specialists), answered the questions completely. After collecting the questionnaires, statistical analysis was performed using SPSS software (Version 13) by descriptive statistics.

RESULTS

The results of the study indicated that only 58.3% of doctors (49 GPs, 21 SPs) knew the units of radiation absorb dose measurement units. Only 10 (20.4%) GPs could correctly estimate the amount of radiation dose received by patients in a routine radiography of hand, but none of SPs answered correctly. 17.8% of GPs (15 from 84), and 25% of SPs (9 from 36) were aware of annual maximum permissible dose to general public. The correct choice about the most sensitive organ to radiation was 81% and 92% by GPs and SPs, respectively.

Results of estimation the received dose by patients in commonly requested radiological examinations proportional to the dose delivered in a routine radiography

of hand are shown in table 1. The percentages of correct, under-estimate and over-estimate are also shown in the table. 10.7% (9) of GPs did not know that sonography had no radiation dose, and all the SPs answered the question correctly. In a similar question about MRI examination, it was shown that 13% of GPs were not aware of the lack of radiation dose in that imaging modality, although all of the SPs answered correctly.

DISCUSSION

The present study showed that an adequate training to doctors was required to reduce the patients' radiation dose [2, 4]. Implementation of radiation protection courses and education of practical issues, including radiation dose received by patients and radiation safety, during medical education programs could be an effective method to reduce the patient's dose in medical exposures [3, 4].

Doctors did not have appropriate awareness about radiation dose delivered by different imaging modalities. The correct estimation of patients' dose by doctors was not also appropriate in the field of plain radiography, CT scan, contrast media

Table 1: Percentage of doctor's estimations about received dose by patients in commonly requested radiological examinations proportional to the dose delivered in a routine radiography of hand.

Percentage of estimations / Type of examination		Percentage of general physicians estimations			Percentage of specialists physicians estimations		
		Under estimate	Correct estimate	Over estimate	Under estimate	Correct estimate	Over estimate
Plain radiography	Chest- PA	0	6.0	94.0	0	8.0	92.0
	Skull-AP	0	15.5	84.5	0	25.0	75.0
	Thoracic-AP	58.4	28.6	13.0	50.0	33.3	16.7
	Lumbar-AP	65.5	27.4	7.1	33.4	33.3	33.3
	KUB	70.2	23.8	6.0	75.3	16.7	8.0
	Lumbar-Lat	0	13.1	0	92.0	8.0	0
	Lumbosacral-Lat	83.2	14.3	2.5	92.0	8.0	0
	Barium swallow	47.0	19.0	7	50.0	16.7	33.3
	Barium follow	77.4	14.3	8.3	53.3	16.7	30.0
	I.V.P	76.3	16.7	7	53.3	16.7	30.0
	Barium enema	68.9	13.1	0	92.0	8.0	0
CT Scan	CT-Skull	71.5	25.0	3.5	58.7	33.3	8.0
	CT-Chest	82.1	25.5	2.4	66.7	33.3	0
	CT-Abdomen	79.8	20.2	0	58.7	33.3	8.0
Mammography	Mammography	97.0	3.0	0	87.0	17.0	0
Angiography	Cerebral	78.5	19.0	2.5	66.6	16.7	16.7
	Abdominal	94.0	6.0	0	75.0	25.0	0
Isotope Scan	Kidneys	79.9	13.1	7	83.3	16.7	0
	Thyroid	82.3	10.7	7	61.1	25.0	13.9

Table 2. Comparing the results of this study with other similar investigations.

		Awareness about lake of radiation dose in MRI	Awareness about lake of radiation dose in ultrasound	Correct estimation of patients received dose			
				Abdominal radiography	Barium meal	Angiographic examinations	Abdominal CT
Shiralkar *et al.* 2003 in UK (4)		92%	95%	%1.5	%5	-	%6
Arslanoglu *et al.* 2006 in Turkey (8)		72.6%	96%	0%	1.7%	2.4%	8.2%
Current study	General physicians	88.1%	89.3%	%23.8	%14.3	%12.5	20.2%
	Specialist physicians	100%	100%	%16.7	%16.7	%20.8	33.3%

radiography, mammography and angiography. Most doctors underestimated the dose delivered in abovementioned radiological examinations. However, their knowledge about sensitive organs response to radiation, as well as low radiation risk examination was found to be ideal.

Although several similar studies were carried out in other countries, there was no evidence for the same study in Iran. The comparison of the achieved through of the current study with other corresponding investigations is shown in table 2. It should be mentioned that other similar studies have used routine chest X-ray (chest-PA) as the assessment criteria of the dose delivering in other examinations. In present study, due to more variation in the dose delivered in chest X-ray radiography, the dose in a hand X-ray was chosen as the reference assessment criterion. Therefore, the differences in some parts have been higher.

In addition, most doctors (about 40 SPs and 70 GPs) didn't admit to participate in this study and didn't read the questionnaire. They have either claimed that they had no awareness about the subject or no time to reply.

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Appendix I: The questionnaire form.

	Questions	Correct answer
1	What are the absorb dose measurements units?	Rad, Gy, Sv, Rem
2	How much is the mean radiation received dose by patients in a routine radiography of hand (hand-PA)?	0.02 mSv
3	How much is the annually maximum permissible radiation dose of general public?	1 mSv
4	What is the most sensitive organ to radiation?	Genital organs
5	If we suppose the radiation dose received by patients in a routine radiography of hand (Hand-PA) as unit, what's your estimation of below mentioned radiological examinations proportional to routine radiography of hand?	

	Radiological investigation	Equivalent No of hand X rays
A	Chest-PA	1-10
B	Skull-AP	2
C	Thoracic-AP	20
D	Lumbar-AP	35
E	Abdomen (K.U.B)	35
F	Lumbar-Lat	100
G	Lumbosacral-Lat	175
H	CT of skull	100
J	CT of chest	400
K	CT of abdomen	500
L	Ultrasound of abdomen	0
M	Ultrasound of kidneys	0
N	MRI of abdomen	0
O	MRI of head	0
P	Barium-swallow	125
Q	Barium-follow	75
R	Intravenous urography (I.V.U)	150
S	Barium-enema	350
T	Mammography	70
W	Cerebral Angiography	370
U	Abdominal Angiography	1000
V	Isotope scan of Kidneys (DMSA)	140
X	Thyroid Isotope scan	50