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Awareness of Radiation among Physicians Dealing with Pediatric Patients

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INTRODUCTION
Medical radiation constitutes approximately 40% of the radiation to which human beings are exposed. The pediatric age group is very sensitive to radiation. Therefore, optimizing requests for radiologic examination is far more important in the pediatric group; thus, physicians' knowledge about medical radiation and as low as reasonably achievable (ALARA) principles, who are in charge of managing pediatric patients was investigated.

MATERIAL and METHODS
In total, 100 surveys comprising 8 questions each were distributed to four hospitals (two university hospitals and two government hospital) and answered by volunteers.

RESULTS
Among 74 responders the awareness of radiation protection was found to be high (95.9%). However, only 23 (31.1%) of the responders were aware of ALARA principles. Contribution of medical radiation to overall was correctly known by 20 (27%), underestimated by 41 (55.4%), and overestimated by 13 (17.6%). Estimation of possible cancer risk was correctly known by 15 (20.3%) of the responders. Informed consent from the parents attributed as valuable for 51 (68.9%) of the responders. Only 8 (10.8%) of the responders had received an education regarding radiation in medical examinations; of these 8, only 3 (4.1%) of them had received formal education.

CONCLUSION
Awareness of medical radiation was higher than reports of previous years, despite lack of formal education. However, majority of the physicians underestimated and a minority overestimated radiation in medical examinations. ALARA is the key principle in radiation protection. In this context, communication between radiologists and clinicians may be established via regular scientific meetings.

Keywords: Radiation, ALARA, pediatrics

INTRODUCTION

Radiologic imaging is very important in diagnosis and handling of patients in both adult and pediatric age groups. Food and Drug Administration classified X-ray as a human carcinogen in 2004 (1). Humans are exposed to low doses of radiation in daily life; radiation from soil, rocks, air, and water is called naturally occurring background radiation. Radiological examinations are another source of radiation.

Computed tomography (CT), being one of the most frequently ordered radiologic examination, is responsible for the majority of radiation to which patients are exposed. After the introduction of CT as a diagnostic tool, since 1972 to mid-1990s, an eight-fold increase in its usage had been demonstrated in high-income countries (2-4). CT accounts for approximately 4% of medical radiologic examination and contributes to 40% of the total collective dose (5).

For a lifetime period children have higher risk for higher dosage of radiation exposure for each organ. . Children are 10 times more sensitive to radiation compared with middle-aged adults (6, 7). Twenty percent of total cancer mortality from

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CT examinations was estimated to occur in children < 5 years of age. Lifetime risk of a young child undergoing a CT was noted to increase approximately by 1/1000 (7). In addition; longer life expectancy in children when compared to adults; makes radiation concept much more important.

The "As low as reasonably achievable" (ALARA) principle emerged to guide the imaging approach to decrease exposed radiation from radiological imaging according to the BY Society of Pediatric Radiology (8). There are numerous studies that demonstrate a low level of awareness of the diagnostic medical radiation among pediatricians (9, 10).

In contrast, radio phobia is also harmful for patients, as it can induce stress and cause avoidance of imaging and misdiagnosis (11). To ensure balance between underestimation of risk of radiation and radio phobia, the knowledge and attitudes of physicians should be primarily documented.

The aim of the present study was to evaluate the knowledge of physicians who deal with the pediatric age group and request radiologic examinations. Physicians who belonged to different specialties who deal with pediatric age group such as pediatricians, ENT (ear, nose, and throat) doctors, neurosurgeons, orthopedics, and doctors working in emergency departments, physical treatment (PT) specialists, and pediatric surgeons were enrolled in the present study.

MATERIALS and METHODS

The study was approved by the ethical committee of Near East University on February 22, 2018, with a code of YDU/2018/55-532. In total, 100 surveys comprising 8 questions each were distributed to two university hospitals and two government hospitals. The survey is shown in Figure 1.

1.Do you think that 'radiation protection' is important for pediatric group of age?
A)Yes B)No

2.Have you ever heard about ALARA principles?
A)Yes B)No

3.Human beings are exposed to radiation from both natural and man-made resources. What is the contribution of medical radiation to total?
A) 1.5 B)5 C)15 D)40 E)90

4.How does the radiosensitivity of a 5-year old child when compared to an adult?
A) Less in children when compared to adults
B) Same with adults
C) 2 times more than adults
D) 5 times more than adults
E) 10 times more than adults

5.Do you think that before performing a radiologic axam, parent shold be informed about the risk of radiation?
A)Yes B)No

6. Have you ever received any education about radiation in medical imaging?
A)Yes B)No

7. If your answer is yes;
A.formal education (lecture, course, radiology rotation)
B.other (personal reading, media,..)

8. Do you believe that you need to increase your knowledge about this topic?
A)Yes B)No

FIGURE 1. Questions in the survey

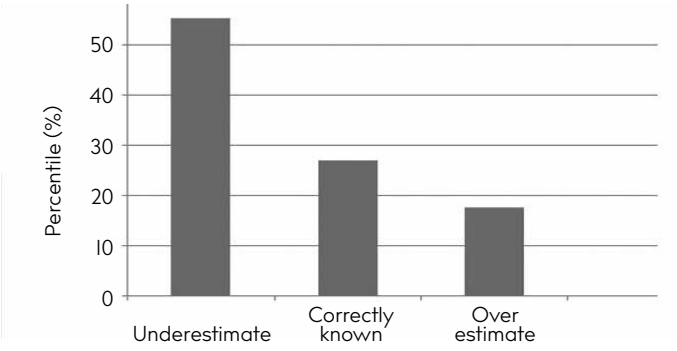

FIGURE 2. Estimation of the physicians about the contribution of medical radiation to overall radiation exposed by humans

Doctors from departments of pediatrics, emergency, pediatric surgery, orthopedics and traumatology, otorhinolaryngology, physical therapy, and neurosurgery who evaluated pediatric age children and could prescribe radiologic examination were requested to participate in the study. Volunteer doctors were also enrolled in the study. Seventy-four surveys were completed and returned.

The data were analyzed using the commercially available software SPSS (Statistical Package for Social Sciences) version 17.0 (IBM Corp.; Armonk, NY, USA). Statistical analysis was performed by using the Chi-square test; $p<0.05$ was considered to be statistically significant. All descriptive data were reported as percentages.

RESULTS

Of the 100 surveys, 74 were completed and returned (74% response rate). In total, 31 (43.2%) from university hospitals and 42 (56.8%) from government hospitals. Twenty-six of the responders were pediatricians, 12 were physicians working in emergency department, 12 were orthopedic and traumatology specialists, 10 were ENT doctors, 7 neurosurgeons, 3 pediatric surgeons, and 4 Physiotherapy (PT) specialists. .

Of the 74 responders, 71 (95.9%) thought that radiation protection is important in pediatric age. Only 23 (31.1%) of the responders had earlier heard about the ALARA principles, whereas 51 (68.9%) had not heard about ALARA principles.

Regarding the question that asked the percentage of contribution of medical imaging to overall radiation, 20 (27%) answered correctly, 41 (55.4%) underestimated the value, and 13 (17.6%) overestimated the value.

In response to the question that evaluated the radiosensitivity of children when compared with adults, 15 (20.3%) responded correctly and 59 (79.7%) underestimated the ratio.

When asked about the necessity of discussion risk of radiation prior to radiologic examination with the parents, 23 (31.1%) of the responders thought that there is no need for routine discussions. Fifty-one (68.9%) of the responders were on the side of informing parents about the risks of radiologic examination.

Among those physicians, no correlation was found when evaluated according to specialty or workplace (university/government hospitals) ($p<0.05$).

TABLE I. Number of correct answers based on the speciality of the responder

	PEDS	Emerg	ENT SPC	PT SPC	Ped Surg	Neu Surg	OTS	Total
Awareness of the importance of protection against radiation (number of correct answers/total) (%)	25/26 (96.2)	12/12 (100)	9/10 (90)	4/4 (100)	3/3 (100)	7/7 (100)	11/12 (91.7)	71/74 (95.9)
Awareness of the ALARA principle (number of correct answers/total) (%)	9/26 (34.6)	5/12 (41.7)	1/10 (10)	2/4 (50)	2/3 (66.7)	3/7 (42.9)	1/12 (8.3)	23/74 (31.1)
Contribution of medical radiation (number of correct answers/total) (%)	10/26 (38.5)	3/12 (25)	2/10 (20)	1/4 (25)	1/3 (33.3)	1/7 (14.3)	2/12 (16.7)	20/74 (27)
The effect of radiation on children when compared with that on adults (number of correct answers/total) (%)	9/26 (34.6)	0/12 (0)	3/10 (30)	1/4 (25)	1/3 (33.3)	0/7 (0)	1/12 (8.3)	15/74 (20.3)
Necessity of informing the parents (number of correct answers/total) (%)	13/26 (50)	9/12 (75)	6/10 (60)	4/4 (100)	3/3 (100)	5/7 (71.4)	11/12 (91.7)	51/74 (68.9)
Education on medical radiation (number of correct answers/total) (%)	4/26 (15.4)	2/12 (16.7)	1/10 (10)	0/4 (0)	0/3 (0)	1/7 (14.3)	0/12 (0)	8/74 (10.8)
Do you want to increase your knowledge? (number of correct answers/total) (%)	26/26 (100)	12/12 (100)	9/10 (90)	4/4 (100)	3/3 (100)	7/7 (100)	10/12 (83.3)	71/74 (95.9)

PEDS: pediatrics; Emerg: emergency physician, ENT Specialist: ear nose throat specialist; PTS: physical therapy specialist; Ped Surg: pediatric surgery; Neu Surg.: neurosurgery; OTS: orthopedic and trauma specialist

Among the responders, 66 (89.2%) had no education about radiation. Only 8 (10.8) of the responders had education about radiation and among those 3 (4.1%) had received formal education.

Seventy-one (95.9%) of the responders considered getting educated about radiation. The answers according to specialty are summarized in Table I.

No statistically significant difference was documented between the responses of physicians from government hospital and those from university hospital.

DISCUSSION

Ionizing radiation is known to be carcinogenic and being especially important in pediatric age group, as children are more prone to harmful effects and they have a longer life expectancy. Human beings are exposed to radiation from the environment and during medical examination. Natural background radiation is estimated to be 3 mSv in 1 y and estimated dose of a flight across country is 0.04 mSv. For clinical examinations, estimated effective doses of single chest X-ray, two-view X-ray, head CT, chest CT, and abdominal CT were up to 0.01, 0.1, 2, 3, and 5 mSv, respectively (12). Most of the medical radiation is because of CT.

Radiation dosage during CT of the red bone marrow and brain were estimated to be associated with leukemia and brain tumors by Pearce et al. (13). In a study conducted on the pediatric age population that involved 11 million patients born between 1985 and 2005 and observed over 10 years, a 24% increase in the incidence of tumors within the group who were exposed to CT scans was documented (14).

When CT scan parameters are not properly adjusted for pediatric patients, small cross-sectional area of the child results in a concentrated dose of radiation in a smaller amount of tissue, resulting in higher effective dose compared with that experienced by adults during scans (15).

There is a general understanding that 30% of all radiologic examinations are not helpful clinically (16). Radiological procedures that are not justified for a specified objective result in excessive, unnecessary exposure of patients to medical radiation (17). For the proper use of radiological imaging, diagnostic tests should be appropriate, justified, and optimized. Appropriate means that the imaging is suitable for the solution of a clinical problem. Justification means to take into consideration the possible risk to health and clinical benefit of the test. Additionally, the examination must be necessary and not replaceable by other diagnostic tests (7, 18). Optimization is related to the concept of image quality and exposure reduction (19). In a recent study performed by Zewdu et al. (20), higher doses of ionizing radiation exposure in children in Ethiopia had been demonstrated. Dose reduction may be possible by education and regular provision of dose information. For a better imaging quality and dose optimizing, dose should be maintained according to the ALARA principles. With this aim, studies involving exposure to ionizing radiation may be performed routinely.

Therefore, principles of ALARA have become much more important for the pediatric age group patients to minimize long-term effects of ionizing radiation.

In our study, 71 (95.9%) of the responders were aware of the importance of radiation protection. However, only 23 (31.1%) of them were aware of ALARA principles. Eleven percent of pediatricians were aware of ALARA in a recent study performed by Ekşioğlu et al. (9). Awareness of CT radiation dose among pediatricians was documented as 15% by Al-Rammah (10). In that study, the knowledge of physicians seemed to be higher than reported. Only 8 (10.8) of the responders had education about radiation, and among those only 3 (4.1%) had received formal education. Educational levels were reported to be between 5% and 37% in different surveys (9, 21-23). This higher rate of knowledge despite low education level of that topic may be due to educational level of the population that supply interaction between physicians and patients both for risks and treatment planning.

Radiosensitivity of children compared with adults was correctly answered only by 15 (20.3%) and underestimated by 59 (79.7%) of the responders.

Regarding the question asking the percentage of contribution of medical imaging to overall radiation, 20 (27%) answered correctly, 41 (55.4%) underestimated the value, and 13 (17.6%) overestimated the value (Figure 2). Overestimation of the risk is higher than a previous report (9). Emerging the topic of radiophobia is important, as it can lead to misdiagnosis.

For CT scans, it has been demonstrated that after exposure, within minutes, an increase in DNA double-strand breaks is induced, and levels of DNA double-strand breaks is higher compared to pre-CT levels. At a time, interval between 5 and 24 h of DNA double-strand breaks was repaired to less than initial level (pre-CT level) except in one patient (24).

In addition, informed consent from the parents attributed as valuable for 51 (68.9%) of responders that is similar to the literature (9). Studies demonstrated that with quantitative information prior to a CT scan about CT related radiation dose and potential risk will not significantly change parent's thoughts to have their child undergoing a CT scan (25).

Seventy-one (95.9%) of the responders consider taking education about radiation. No statistically significant difference was detected between the responses of physicians from university or government hospitals. This may be due to small society and the interaction between doctors working in university and governmental hospital.

Our results indicate that the awareness of medical radiation among physicians in charge of pediatric patients is high but awareness of ALARA is low. There is no standardized education for medical radiation. A post-graduate educational program about the risks of ionizing radiation and communication between radiologists and clinicians with regular scientific meetings may fulfill the demand in the way of increasing knowledge about medical radiation and optimizing requests of radiological examination.

Ethics Committee Approval: Ethics committee approval was received for this study from the Institutional Review Board of Near East University (Approval Date: February 22th, 2018; Approval Number: YDU/2018/55-532).

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