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RESEARCH ARTICLE

KNOWLEDGE OF COMMON RADIOLOGICAL INVESTIGATIONS IN EMERGENCY SETTING BY PHYSICIANS IN BAHRAIN

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Abstract

Introduction:-

Radiological imaging modalities serve as a cornerstone of diagnosis andmanagement of a variety of medical conditions andthus are increasingly used by numerous physicians across differing specialties [1]. Nevertheless, it is well established that radiation exposure poses a risk towards patients' safety, particularly the risk of future cancer development[1].However, different imaging modalities have different levels of radiation risk towards patients[2].

One radiological investigation that has been increasing in frequency upon Emergency Department (ED) visits is the Computed Tomography (CT) scanning[2]. This imaging modality has been noted to account for almost 1 in 7 of ED visits in the United States on an annual basis and although it serves as a sensitive and specific diagnostic tool it does come with the risk of exposure to ionizing radiation[2].One of the more significant risks of ionizing radiation is the lifetime cancer risk[3]. Compared with adults, due to their continuously growing tissues, children are at a higher lifetime risk of cancer development after exposure to radiation since they have a longer time spam to potentially develop cancer[3].

In the Kingdom of Bahrain there is a large number of ED visits on an annual basis to private and public health care facilities, most notably to Salmaniya Medical Complex (SMC), which reached around 300,000 visits in the year 2020[4]yet to the best of our knowledge no studies were conducted previously in Bahrain to assess the knowledge of radiation exposure for commonly requested radiological procedures amongst physicians in the ED.Conversely, similar studies have been conducted internationally to shed light on this issue and demonstrated that doctors working in EDs have inadequate knowledge of the ionizing radiation risks associated with the radiological investigations they order [1,5]. A recent study conducted in the nearby Kingdom of Saudi Arabia (KSA) published in 2018 concluded that doctors working in an ED had poor knowledge about the radiation doses received by their patients, and poor knowledge about the risks associated with the radiation exposure[1].

The aim of this study was to assess the knowledge of radiation doses and risks among doctors working in the Emergency departments in the Kingdom of Bahrain.

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Methodology:-

In this cross-sectional observational study, a questionnaire was distributed to physicians of different levels of training as well as post boardcertification level who were actively practicing medicine in ED in private and public hospitals across the Kingdom of Bahrain during May 2022. All participantswere oriented towards the purpose of the study prior to starting the questionnaire and electively agreed to participate in the study and was completely voluntary and anonymous.

The questionnaire that was used in this study was validated and used in two previous studies, originally the Gunlap et al [6] conducted in Turkey in 2013 and then by Barnawi et al [1] conducted in KSA in 2018. It included a total of 18 questions divided into 3 parts. The first part inquired about the participants' demographics such as their specialty, level of training denoted by Resident doctor (still in training), board-certified specialist or consultant and if they previously undertook any courses regarding ionizing radiation.Furthermore,participants were asked about the average number of patients seen as well as average number of CT/X-ray examinations ordered within an 8-hour ED shift.

Moreover, the second part of the questionnaire examined the participants' knowledge of ionizing radiation doses associated with different radiological investigations. They were asked to estimate the radiation dose associated multipleimaging modalities including those that use ionizing radiation as well as some which do not, specifically Ultrasound (US) and Magnetic Resonance Imaging (MRI). Participants had to choose the radiation doses in each of the different modalities as well as provide an equivalent of the number of Chest X-rays (CXR) each of these modalities was exposing the patient towards. The standard of doses and CXR equivalents was obtained from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) report[7]. This can be referred to in Appendix image A.

In addition to that, the last part of the questionnaire evaluated the participants'knowledge concerning the lifetime risk of cancer development due to ionizing radiation and their selection of imaging modalities in pregnant patients includingany possible risks to the fetus. Finally, participants were askedif they would inform their patients about the risks of radiation before undergoing a radiological test.

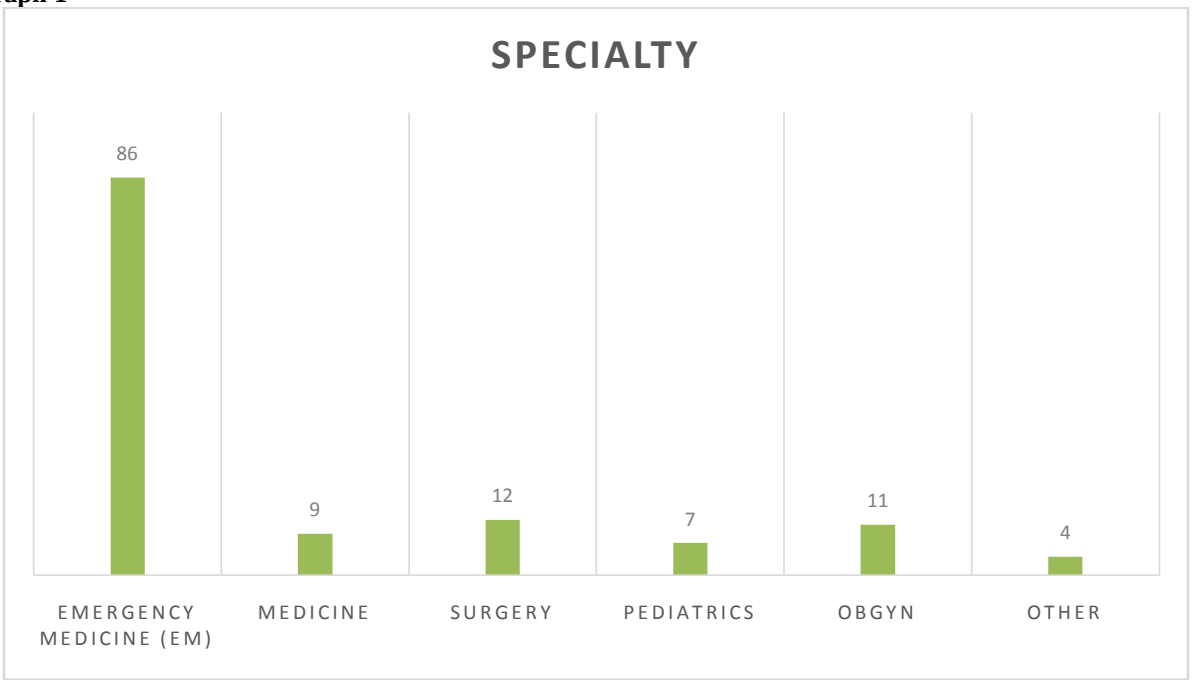
Statistical Analysis

Statistical Package for the Social Sciences (SPSS)version 23 was used in order to analyze the Data. Chi Square test was used for categorical values and Independent T test was used for the continuous data. P-Values of <0.05 were considered statistically significant.

Results:-

One hundred and Twenty-Nine Physicians completed the questionnaire and as illustrated from Graph 1 most of whom (67%) were Emergency medicine physicians. Furthermore, 107 (83%) of respondents were Residents/Trainees whereas 18 (4%) were board certified and only 4 (3%) were consultants.

Graph 1



In addition to that, only 13 (10%) of respondents underwent prior training/courses in radiation exposure. The Mean + Standard Deviation (SD) of patients seen during an 8-hour ED shift was 16+4 patients and the number of CT/x-rays requested during that same time period was 8+3.

Table 1:- Radiation Dose Estimation.

	Correct equivalent Number of CXR	More than equivalent Number of CXR	Less than Equivalent Number of CXR	Does not Know
Abdominal Xray (AXR)	65(50.3%)	18(13.9%)	9(6.9%)	37(28.6%)
Pelvic Xray	73(56.5%)	20(15.5%)	7(5.4%)	32(24.8%)
Skull Xray	51(39.5%)	38(29.4%)	12(9.3%)	28(21.7%)
Abdominal CT scan	21(16.2%)	3(2.3%)	62(48.0%)	43(33.3%)
Chest CT Scan	14(10.8%)	6(4.6%)	49(37.9%)	69(53.4%)
Pelvic CT scan	12(9.3%)	5(3.8%)	50(38.7%)	62(48.0%)
Skull CT Scan	16(12.4%)	9(6.9%)	35(27.1%)	69(53.4%)
Abdominal MRI	74(57.3%)	2(1.5%)	21(16.2%)	32(24.8%)
Abdominal US	81(62.7%)	0(0%)	13(10.0%)	35(27.1%)

Table 1 demonstrates the overall knowledge of respondents regarding radiation doses. As shown, the average correct dose estimation was 35% whereas the average overestimation and underestimation percentages were 8.6% and 22% respectively. On average, 35% of respondents answered "Don't Know" when asked to estimate a specific radiological test estimated radiation dose in equivalent number of CXR.

In addition to that, respondents who had prior training or undertook courses regarding radiation exposure showed a higher average percentage of correct radiation exposure estimation, which was 58% compared to those without prior training 33% ($p = 0.021$).

Concurrently, EM physicians had a higher average of average correct radiation exposure at 41% whereas the lowest was OBGYN which was 22% ($p = 0.04$). Conversely, no statistical significance was noted when comparing average correct radiation exposure percentages between different levels of training ($p = 0.792$).

Table 2:- Knowledge of radiation risks

Knowledge about lifetime cancer risk	
Does a single Abdominal CT scan in childhood increases Lifetime risk of cancer development?	
Yes	38(29.4%)
No	91(70.6%)
Radiology imaging consent	
Do you inform your patient about radiation exposure risk before ordering a radiological image?	
Yes	16(12.4%)
No	113(87.6%)
Knowledge about Request during pregnancy	
I never order a diagnostic radiological investigation for pregnant patient	28(21.7%)
I follow the advice of OBGYN regarding radiological investigations for pregnant patients	12(9.3%)
I request any radiological investigation to pregnant patients as there is no risk	2(1.5%)
I order radiological examinations to pregnant patients as long as they wear protective Lead covering	19(14.7%)
I weigh advantages vs risks of radiological exam for pregnant patients and inform them about potential risks	68(52.7%)
Knowledge about fetal risk	
Which of the following modalities carries lowest risk to a fetus?	
Chest CT	21(16.2%)
Abdominal x-ray	38(29.4%)
Pelvic x-ray	12(9.3%)
Lumbar vertebra x-ray	56(43.4%)
Abdominal CT	2(1.5%)

As seen in Table 2, only 29.4% of respondents correctly answered that a single abdominal CT scan in childhood increases lifetime cancer risk and only 12.4% of them notify their patients regarding the potential risks involved in undertaking a radiological exam prior to it being performed. With respect to their actions when ordering a diagnostic radiological exam for pregnant patients, 52.7% of doctors responded that they weigh the pros and cons and notify the patient about the potential outcomes prior to ordering the exam.

Finally in regard to the question assessing the respondent's knowledge about the fetal risk of radiation, 21% correctly answered that the study with the lowest risk for the fetus is the chest CT scan when compared to the other imaging modalities given in the options.

Discussion:-

The objective of this study was to assess the knowledge of radiation exposure for common radiological investigations amongst physicians practicing in the Emergency department in Bahrain. This included EM physicians as well as any trainees/residents from other departments who were rotating in the Emergency Department at the time of the survey. The results demonstrated varying accuracy of dose estimation per radiological investigation, however the overall average correct dose estimation was 35%. This represents that around two thirds of physicians requesting radiological investigation in EM incorrectly estimate the radiation risks. Unexpectedly, only 57.3% and 62.7% of respondents correctly assessed that Abdominal MRI and Ultrasound did not cause radiation exposure respectively. These results coupled with the average number of patients seen and investigations requested per 8-hour shift, 16 and 8 respectively, shows the significance of potential harmful outcomes that may arise from improper use of radiological modalities. One way to alleviate this issue could be by providing more training courses regarding the radiation exposure as our results showed that there is a significant ($p = 0.021$) increase in correct dose estimation in those who had some prior training.

Moreover, Emergency physicians had a higher correct dose estimation rate (41%) than did physicians from other specialties, whereas OBGYN had lowest (22%) rate. This result is worrying because in pregnancy, two patients (Mother and fetus) are being exposed and fetal congenital anomalies caused by radiation exposure is well documented [7]. Consequently, OBGYN physicians should especially have a higher level of knowledge about radiation doses and their effects.

Our findings are comparable to a similar recent study conducted in the neighboring country of Saudi Arabia in 2018,Barnawi et al, which demonstrated a slightly lower correct dose estimation amongst their respondents, around one fifth compared to one third in our study however their findings showed that EM physicians have the highest average correct estimation which is the same as this study's finding [1]. This could be attributed to the fact that EM physicians utilize different radiological investigations on a daily basis and hence will have a better understanding of these common tests. Additionally, only about half (52.7%) of respondents reported discussing the potential risks of radiation exposure with patients before ordering an examination; this proportion is lower than those reported in previous studies that reported in Barnawi et al (63.1%) but higher than what was reported in previous conducted studies by Gunlap et al in 2014 and Soye J et al in 2008 [1,6,8]. Strikingly, only 29.4% of respondents correctly answered that a single childhood Abdominal CT scan can increase lifetime risk of cancer development, this result needs to be emphasized since it was previously discussed before that lifetime risk of cancer is higher in children than adults and poor knowledge of radiation exposure.

The usefulness of radiological investigations in patient care is undoubted nevertheless, the numerous risks resulting from such examinations should always be considered and communicated to patients and these studies must be requested only when the benefit outweighs the risk. This study exhibited that physicians working in an ED had poor knowledge about the radiation doses received by their patients as well as poor knowledge about the risks associated with the radiation exposure; a finding that has been previously replicated by various studies in multiple locations. This mattermeritsconsiderationgiven the rising use of radiological investigations.

Limitations

The respondents to the questionnaire were mostly residents/trainees who did not achieve board certification or consultant status and thus the small sample of those categories will limit ourdata regarding knowledge of radiation exposure amongst physicians who progressed and completed advanced training.Another possible limitation to this study was the discrepancy between what respondents might perceive as prior radiation exposure course/training as this definition can be subjective and different courses can provide either a deeper or more shallow explanation of the topic.

Moreover, the questionnaire did not identify if respondents were practicing in private or public hospitals. This is of importance since knowledge of potential risks when ordering the investigations may vary between those who frequently do so versus those who could possibly not have advanced imaging such as a CT scan in their facility and require to refer patients for more tertiary care.

Conclusion:-

These results show that the overall knowledge varies between specialties but still remains inadequate. Emphasis should be made by training programs and hospitals in mandating courses for physicians of all specialties regarding the risks associated with radiation exposure as well as increasing the ability of physicians to discuss effectively with their patients the need for any specific test and the risks versus benefits involved per investigation before taking the decision to perform imaging.

Appendix Image A

Radiation dose for various radiological modalities compared to CXRincluding the knowledge on doses received by patients that were considered acceptable

Diagnostic imaging modality	Effective dose (mSv)	Equivalent number of chest x-rays resulting in the same effective dose	Following ranges are accepted (based on equivalent number of chest x-rays)
Chest x-ray	0.02	1	1
Cranial x-ray	0.07	3.5	0-10
Pelvic x-ray	0.7	35	10-50
Abdominal x-ray	0.7	35	10-50
Cranial CT	2.4	120	50-200
Chest CT	7.8	390	200-500
Abdominal CT	12.0	600	>500
Pelvic CT	10.5	525	>500
Abdominal US	0	0	0
Abdominal MRI	0	0	0

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Conflict of Interest

The authors of this study have no conflict of interest to disclose and this study was not sponsored by any medical equipment company or dug manufacturer.

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