KNOWLEDGE OF RADIATION RISK OF COMMONLY PERFORMED RADIOLOGICAL EXAMINATIONS AMONG REFERRING PHYSICIANS AT AMINU KANO TEACHING HOSPITAL, NIGERIA

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ABSTRACT

BACKGROUND: Radiological examinations are of great importance in the field of Medicine. The dose of radiation given in any diagnostic procedure should be enough to answer the relevant clinical question, but as low as reasonably achievable to lower the risk to the patient. Therefore, it is important that physicians requesting the imaging are well-trained in deciding the diagnostic imaging indicated, and have an accurate knowledge of the associated risks. **AIM:** To evaluate the knowledge of radiation dose for commonly performed radiological examinations among referring physicians in Aminu Kano teaching hospital (AKTH). **METHOD:** This was a prospective and study conducted at AKTH, Kano, Northwestern Nigeria. A questionnaire was distributed to all cadres of medical doctors apart from Radiologists. Radiological investigations were listed and participants were asked to estimate equivalent doses using the dose of posteroanterior chest x-ray as a reference. Questions on knowledge of radiation hazard, radiation measurement units, and the use of referral guidelines were also included. A total score was aggregated for each question. **RESULT:** A total of 90 questionnaires were distributed, and 70 were returned. The gender for the study includes 65.7% male and 34.3% females. Most of the physicians knew about ionizing radiation but very few of them (2.9%) knew its unit of measurement. The majority of the physicians were unable to estimate the doses for most of the radiological exams. Only 32.9% of the physicians were familiar with the stochastic and non-stochastic effects of radiation. Knowledge of the use of referral guidelines was found to be average, while knowledge on the non-ionizing nature of USS was adequate but for MRI it was found very insufficient (5.7%). **CONCLUSION:** These study findings revealed that most physicians were aware of radiation hazard but did not have appropriate awareness about radiation dose delivered by different imaging modalities and the effects of irradiation. Implementation of radiation protection courses and education on practical users, including radiation dose received by patients, radiation safety and justification of referral for imaging to physicians could be an effective method to reduce patient dose in medical exposures.

Keywords: Physicians, Radiation dose, Knowledge, Radiological Examinations.

Introduction

The radiation dose is the amount of energy deposited in a medium.[1] Different x-ray modalities address radiation doses in different ways. Radiation doses are expressed as entrance skin dose in radiography and average glandular dose in mammography.[1] In computed tomography (CT), the radiation dose is expressed as CTDI (computed tomography dose index) which quantifies the amount of radiation

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received by the patient in CT. Estimates for dose using CTDI-vol or dose length product (DLP) are based on ideal phantom model testing, either a 32 cm water phantom to represent an average adult or a 16 cm water phantom for an average pediatric patient.[2] In fluoroscopy, the convenient and widely used method for indirect monitoring of dose is the dose area product (DAP) Meter.[3]

Diagnostic imaging and interventional radiological techniques are increasingly used to diagnose a wide range of injuries and diseases, and to give life-saving treatment for many diseases.[4] The use of radiation in medical practices has evolved since its beginning and 30% to 50% of medical decisions are based on radiological examinations.[4] However, it is still limited by its relevant hazards to patients and healthcare providers.[4]

Radiological examinations play a very vital role in medicine and patients that come for radiological investigations are usually being referred by physicians from various clinics. Published studies has shown that there is a lack of adequate knowledge of radiation among doctors.[5,6] It has also been noted that most of the doctors are submitting their patients to a radiation dose that is 16 times larger than they thought it was and it has been shown that the average mean dose of irradiation is six times the quantity estimated by the doctors.[5] Almost every specialty requires the input of a radiological investigation to diagnose and determine management plans for patients. Ranging from a staging CT in oncology, to interventional endovascular treatments, radiology continues to play a key role.[6]

In any diagnostic procedure, the dose of radiation given should be enough to answer the relevant clinical question but as low as reasonably achievable to minimize the risk to the patient. Modern imaging equipment allows adjustment for patient size and anatomy, this is important, as the lifetime attributable risk of fatal cancer for children exposed to radiation is substantially higher than for adults.[7]

Among all radiological examinations, the doses of CT are the highest.[4] The typical exposure dose for an abdominal CT is 9 mSv and that for one chest radiograph is 0.02 mSv.[4] Thus, methods relying on ionizing radiations should be rationally utilized, taking their risks and benefits into consideration, and whenever possible, preference should be given to methods that do not rely on ionizing radiation, and to the utilization of the minimum dose required to solve the clinical doubt.[8] The average radiation dose received annually by the public is 2.5 mSv, and 15% of them are related to medical exposures.[4] Since radiation has documented harmful biological effects that vary with the dose and duration of exposure, the knowledge of physicians' awareness of such matters including associated risks is important.[9] As physicians refer patients for such investigations, they obviously bear some responsibility under the Ionizing Radiation (Medical Exposure) regulations.[9]

The level of awareness concerning radiation protection influences staff behavior.[4] If they have not enough information related to radiation safety, their actions will not be safe and be resulted in adverse effects.[4] The current challenges should not be only to address new policies and procedures but need a better understanding of the frequency and causes of errors, particularly those that are most likely to cause harm.[4] Although radiological imaging in medical diagnosis in hospitals plays an important role and benefits millions of people, the promotion of awareness about the dangers of ionizing radiation is important.[10] It is very important that physicians are well trained in diagnostic imaging involving the use of ionizing radiation and have good knowledge of the associated risks. This is especially significant in each health structure, where many radiological imaging exams are requested each day, often in a time-pressured environment.[7]

This aim of the study was to evaluate the knowledge of radiation dose for commonly performed radiological examinations among referring physicians in Aminu Kano teaching hospital (AKTH).

Materials and Methods

A prospective and cross-sectional study was conducted among referring physicians in Aminu Kano Teaching Hospital after approval from ethical review board. Convenience sampling technique is adopted, where participants are selected based on availability and willingness to participate.

The inclusion criteria for the study were all referring physicians that work at AKTH while the exclusion criteria were all Radiology doctors and Physicians

outside the study site AKTH. The data is been collected by means of a questionnaire; the questionnaire is designed according to the objectives of the study and distributed to the participants. The questionnaire comprises two sections: the first part comprises demographic information of the participants such as age, gender, year of experience and qualification. The second part comprises of questions on basic radiation knowledge, knowledge on radiation exposure/doses, radiation protection and optimization principles (the ALARP principle), knowledge on the effects of ionizing radiation and use of referral guidelines. Data was acquired by compilation of filled questionnaires; it was organized in an orderly manner and classified. The data was analyzed using statistical package for social sciences (SPSS) version 23.0. The distribution of variables is assessed using descriptive statistics.

Result

	Frequency	Percentage %
Gender		
Male	46	65.7
Female	24	34.3
Age (years)		
25-30	11	15.7
31-40	50	71.4
41-50	9	12.9
Qualification		
Consultant	9	12.9
Resident	47	67.1
Medical officer	11	15.7
House officer	4	4.3
Years of experience (years)		
1-5	17	24.3
6-10	31	44.3
>10	22	31.4
Total	**70**	**100**

Table 1: Demographic distributions

Questions	Correct response %	Wrong %
Definition of radioactive radiation	88.6	11.4
Unit of radioactivity	2.9	97.1
Annual radiation dose limit to patients	12.0	88.0
A person annual radiation dose from natural background radiation	45.7	54.3
Radiation dose of a single chest x-ray	18.6	81.4
Aware of the ALARA principle	42.9	57.1

Table 2: Basic Radiation knowledge

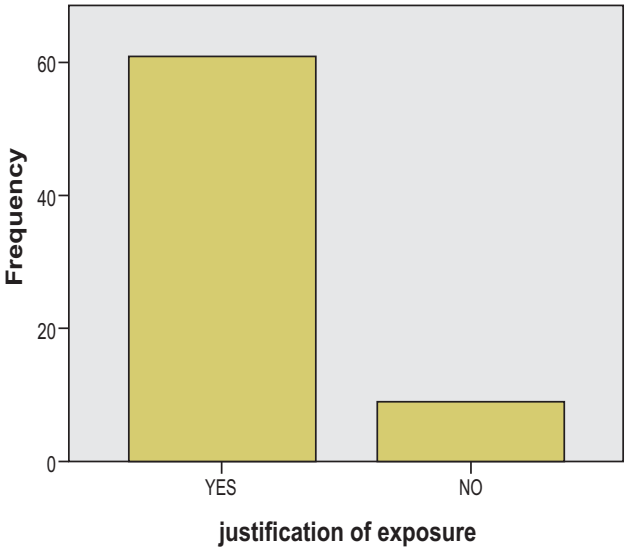

Figure 1: Justification of exposure in relation to any alternatives

87.1% (61) of the physicians do justify an examination in response to an alternative while 12.9% of them do not.

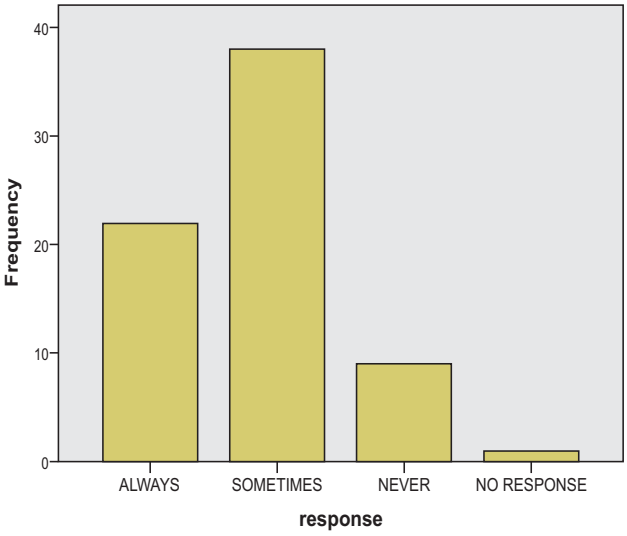

Figure 2: Explaining the risk versus benefit of exposure to patients

54.3% of the physicians sometimes explain the risk, 31.4% of them always do while 12.9% of them never explain to patients when obtaining consent for examinations involving radiation.

Responses	Frequency	Percentage %
Yes and used it	38	55.0
No	32	45
Total	70	100

Table 3: Aware of Imaging Referral Guidelines

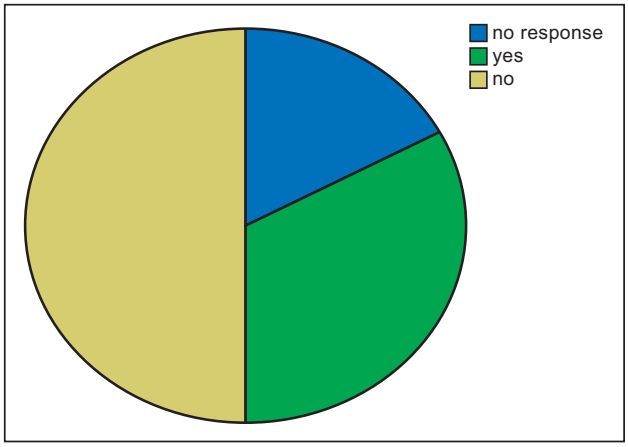

Figure 3: Effects of radiation

Most of the physician's 35 (50%) were not familiar with the stochastic and non-stochastic effects of radiation, only 23 (32.9%) were familiar with them. Out of which only 18 (25.7%) classified all the listed potential detrimental effects of radiation into stochastic and non-stochastic

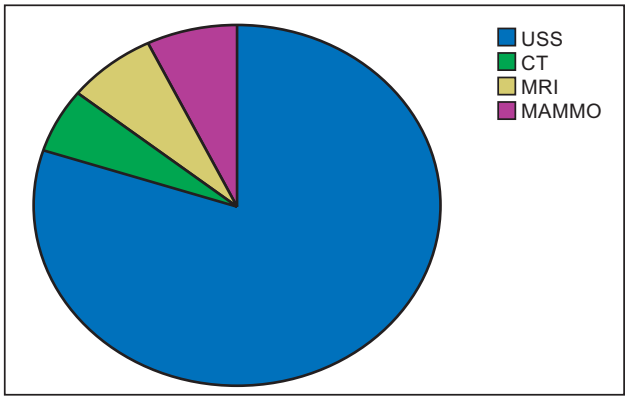

Figure 4: None ionizing nature of MRI and USS

56 (80.0%) of the physicians knew that USS doesn't involve ionizing radiation, but only 4 (5.7%) know that MRI lacks ionizing radiation. 7.1% did not respond to the question.

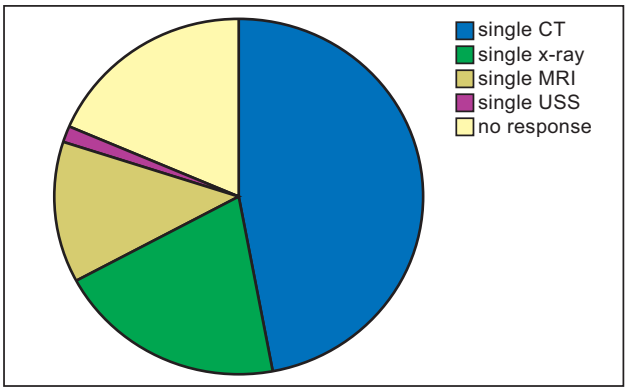

Figure 5: Modality with the highest radiation dose

33 (47.1%) of the physicians knew that CT has the highest radiation dose, 14 (20%) select a single x-ray, 9 (12.9%) for MRI and 1.4% for USS. While 13 (18.6%) did not respond to the question.

Types of exam	Under-estimate %	Correct estimate %	Over-estimates %	Don't know %
Plain abdomen	54.2	8.6	0.0	31.4
Pelvis	52.9	15.7	0.0	31.4
IVU	67.1	1.4	0.0	31.4
Lumbar spine	62.9	5.7	0.0	31.4
MRI brain	0.0	7.1	61.4	31.4
Abdominal USS	0.0	22.9	45.7	31.4
CT abdomen	62.9	4.3	0.0	31.4
Mammography	22.9	20.0	25.7	31.4

Table 4: Percentage of physician's estimations of radiation dose absorbed by patients during radiological investigations using the dose of chest x-ray as a reference

Majority of the physicians could not correctly estimate the dose delivered in the listed radiological examinations, they either underestimate the dose or could not attempt the questions.

Studies	Awareness about lack of radiation dose in MRI	Awareness about lack of radiation dose in USS	Correct estimation of patients received dose in abdominal CT
(Ahidjo et al., 2012)	14%	20%	6.2%
(Arslanoglu, Sibel, & Kubal, 2007)	72.6%	96%	8.2%
(Shiralkar, Rennie, snow, Galland R B, & Lewis M H, 2003)	92%	95%	6%
(Gour et al., 2017)	85%	97%	30%
Current study	5.7%	80.0%	4.3%

Table 5: Comparing the result of this study with other similar studies

The comparison from other similar studies by Arslanogluet al. (2007) in Turkey, Shiralkaret al. (2003) in UK and Gouret al., (2017) in India showed that the physicians had better awareness about the lack of ionizing radiation in MRI than Nigerian physicians.

Discussion

From the demographic data (Tab.1) on the gender and age range of the participants, the majority of them are male (65.7%), with females accounting for about 34.3%. This is similar to a study conducted by Ahidjoet al. (2012)[5] in Nigeria where the majority of the physicians are male (64.6%). Similarly, in a study conducted also shows 78.7% of the physicians are also male.[4] These show that in most of the researches there are more male physicians than females in Nigerian hospitals. On the age range, most of them are within the range of 31-40 years (71.4%). The majority of the participating physicians 47 (67.1%) are resident doctors and 31 (44.3%) of them are within 5-10 years of experience. Most of the participants were resident doctors (67.1%). this is strongly supported by Ahidjoet al. (2012) was the resident doctors account for 47.6% and 53.2% respectively.[5] This is because resident doctors are many and are found at all-time in the wards or clinic at AKTH and most Nigerian hospitals.

This study highlighted that 88.6% of the physicians knew about ionizing radiation but only a few of them (2.9%) knew its unit of measurement (Tab.2). This is similar to a study conducted by Ahidjoet al. (2012)[5] whereby only 38.5% of the physicians know the radiation unit.

Also, only 42.9 % of the physicians were able to identify the ALARA principle (Tab.2). Similarly, this lack of knowledge of radiological facts was certainly evident, with only 27% of the physicians able to identify the ALARA principle in India by Gouret al., (2017), even though this principle comprises the core of radiation protection philosophy.[9] This is of main concern especially when high radiation doses are used as a screening tool or repeatedly to monitor disease progression.

Most physicians did not know the dose delivered in the aforementioned radiological examinations (Tab.4). Most of them either underestimate the dose or could not attempt the questions. The estimated dose of some radiological examinations is much lower than the correct ones. This is in keeping with the findings of previous studies.[5,7] Underestimation of the actual dose of ionizing radiation might lead doctors to request radiological examinations more often than is necessary and safe.

The majority of the physicians do not always delineate the risks and benefits of radiation exposure to patients when obtaining informed consent for investigation involving radiation (Fig.2) as only 31.4% of them do such. This is with reference to the study conducted by Gouret al. (2017) with a frequency rate of of 38% of the physicians.[9] Patients undergoing investigations such as abdominal CT are often poorly informed about possible associated hazards. This probably relates to the poor physicians' knowledge of radiation doses, and associated harmful effects.

Only 5.7% of the physicians (Fig.4) in this study knew that MRI has no ionizing radiation. This is similar to a study conducted by Ahidjoet al. (2012) in Nigeria where only 14% of the physicians had that knowledge. This shows that physicians in more efficient developing countries knew that MRI doesn't involve ionizing radiation than those in less efficient developing countries (like Nigeria). This may be due to the lack of MRI equipment and specialists in Nigeria.

However, the majority of the physicians (80.0%) knew that USS can be used safely for pregnant women (Fig.4). This was similar to the findings in UK by Shiralkaret al. (2003) 95% and in Turkey by Arslanogluetet al. (2007) 96%. This shows that the physicians have adequate knowledge of USS not involving ionizing radiation.[1,7,9]

(Tab.3) shows that 45.0% of the physicians knew about referral guidelines but haven't used it, while 55.0% knew and used it. This was above the findings of Ahidjoet al. (2012) as only 41.5% of the physicians were aware of the imaging referral guidelines. This shows that their knowledge on the use of referral guidelines is increasing.[5]

(Fig.3) shows that most of the physician's 35 (50%) were not familiar with the stochastic and non-stochastic effects of radiation, only 23 (32.9%) were familiar with them. Out of which only 18 (25.7%) classified all the listed potential effects of radiation into

stochastic and non-stochastic. This showed that most of the physicians did not know the detrimental damage cause by radiation exposure on the human body. This poor knowledge of radiation effect was also proven by Ahidjoet al. (2012), were only 23.1% of the physicians correctly classify the radiation injuries into stochastic and non-stochastic effects.[5]
The comparison from other similar studies showed that the physicians in Turkey, UK and India had better awareness about the lack of ionizing radiation in MRI than those in Nigeria.[9,10]

Conclusion

There is good awareness of radiation hazard among the physicians but with limited knowledge and effects of radiation. There was minimal knowledge on the use of referral guidelines and radiation protection. Such knowledge is particularly useful in the justification of radiation use which will drastically reduce radiation dose to the population.

Conflict of Interest: None

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