Knowledge and practice of Health Care Workers regarding radiographic imaging in women of reproductive age group at Aminu Kano Teaching Hospital, Kano

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Abstract

Background: Current clinical practice in many developing settings often requires the use of ionizing radiation for diagnosis. However, there are potential hazards when women of reproductive age are subjected to ioninzing radiation and healthcare workers should have safeguards to prevent unsafe exposures as they may relate to pregnancy. This study aimed at assessing the knowledge, perception of risk and safeguards involved in radiographic imaging of women of reproductive age group by healthcare workers at Aminu Kano Teaching Hospital, (AKTH), Kano, Nigeria.

Methods: This was a cross sectional descriptive study of 202 doctors, radiographers and physiotherapists in AKTH using a pre-tested self-administred questionnaire. Additionally, 117 radiological investigations request forms were reviewed for women within the reproductive age group only for imaging modalities that utilize ionizing radiation taken in AKTH.

Results: Majority of the respondents underestimated the fetal doses from conventional X-ray imaging modalities. Only 20% of respondents suggested that the risk to the fetus begins at radiation dose of 10mGy. Only 16% of the radiological forms reviewed had the column for last menstrual period completed with the required information on radiological request forms despite 97.9% of respondents indicating the use of last menstrual period as a means of screening for pregnancy. There was no relationship between the knowledge of guidelines on when/how to screen for pregnancy with respondents years of service (p= 0.475).

Conclusion: The overall knowledge of healthcare workers regarding safe radiation fetal doses was inadequate. The level of compliance with guidelines stating when and how to screen for pregnancy was poor.

Key words: ionizing radiation, pregnancy, knowledge, safeguards, healthcare workers.

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Introduction

Advancing technology is improving the relevance of ionizing radiation in clinical practice and research since the discovery of X-rays on 8th November, 1895.[1] However, fetal exposure to ionizing radiation can either induce teratogenic malformations or cancer in later life[1,2]. Thus, care must be taken by health care workers regarding radiographic imaging in women of reproductive age group based on practice guidelines set by the International Atomic Energy Agency (IAEA), International Commission on Radiological Protection (ICRP) and other regulatory bodies.[2-4]

In women of child bearing age, it is important to determine who is or could be pregnant, prior to radiation exposure due to the dangers of ionizing radition on the developing fetus.[2] According to ICRP, thousands of pregnant women are exposed to medical ionizing radiation each year.[3-5] The knowledge of the possible hazards to the patients and the fetus at doses used for different imaging procedures has been widely researched and safety measures have been recommended.[2-5]

Contrast medium in radiographic examinations (including computed tomography) are known to have poor lipid solubility and less than 1% of the dose enters breast milk, furthermore, less than 1% of the ingested dose is absorbed. Thus no adverse effect has been reported[6].

This study aimed at assessing the knowledge, perception of risk and safeguards involved in radiographic imaging of women of reproductive age group and the safeguards by healthcare workers at Aminu Kano Teaching Hospital, Kano (AKTH).

Materials and Methods

This study was carried out in Aminu Kano Teaching Hospital (AKTH) Kano, Nigeria. Its Radiology Department is equipped with more than ten ionizing radiation dispensing facilities including computed tomographic scanners, fluoroscopy, angiography and mobile X-ray units.

The study population included radiographers, physiotherapists and medical doctors in the departments of surgery, internal medicine, radiology and family medicine. These were selected by simple random sampling from a list of all clinical departments that uses ionizing radiation for patient management in AKTH.

For this study, the prevalence value used to calculate the sample size was obtained from a study[1] on radiation safety for women of reproductive age: which showed that

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percentage prevalence of physicians that do not screen for pregnancy was 98.9%.

Sample size was calculated using the formula for minimum sample size.

$(n = Z^2 pq/d^2)$....[7]

Where,

n = minimum sample size.

Z = Standard normal deviate corresponding to 99% confidence interval on the normal distribution Curve = 2.58

p = Proportion obtain from previous study = 98.9%[1] (0.989)

q = Complementary Probability of p

= 1 – p

= 1 – 0.989 = 0.011

d = degree of precision or margin of error allowed at 99% confidence limit = 1% = 0.01

Therefore, $n = \frac{Z^2 pq}{d^2}$

$$= \frac{(2.58)^2 \times 0.989 \times 0.011}{(0.01)^2}$$

$$= \frac{6.66 \times 0.989 \times 0.011}{0.0001}$$

$$= 724.5$$

$$= 725$$

The finite correction of sample size was applied, as the study population had less than 10,000 members.

N= population size =280 (this was arrived at by totaling the number of consultants and registrars' in radiology, surgery, internal medicine, GOPD, and radiographers and physiotherapists. The numbers of staff on leave and on out postings were excluded from the total estimated population).

n= sample size as calculated using the 99% CI = 725

n 725 280= 2.59

This is greater than 0.01(1%) thus the formula for finite correction of sample size would apply.

Using the finite corrected formula to estimate the sample size.

$$N_0 = \frac{n*N}{n + (N-1)}$$ [34.........8]

$$= \frac{725*280}{725 + (280-1)}$$

$$= 202.191$$

$$= 202$$

The finite corrected sample size is 202.

A multistage sampling technique was adopted in the study; five departments were selected using a simple random number table from a list of the entire departments where services are offered.

Proportionate allocation was used to determine the number of respondents to be selected from each department. Balloting was used in each department to determine the respondents.

The tool was adapted from earlier study[1] and was pre-tested for clarity, appropriateness and internal consistency, with appropriate re-phrasings after the pre-test to improve calarity.

In the questionnaire section regarding knowledge of radiation doses, the estimated fetal doses from conventional x-ray imaging modalities were provided among the options alongside other options which underestimate or overestimate the correct dose. A number of values were provided under 10mGy while other values were provided above 10mGy, and during analysis all responses were individually classified as either correct, underestimate or overestimate for the imaging modality and body region based on an earlier established values of what dose of radiation the fetus is subjected to.[1] Frequencies were tabulated for correct estimates and for under and over-estimations.

Request forms of women in the reproductive age group who required imaging modalities involving ionizing radiation from different time frames were retrieved from the archives , the forms were assessed for completeness of age and LMP. The prevalence value used was obtained from an earlier study in Nigeria[1] showing 86.67% completeness of the age and LMP of request forms for women within the reproductive age group who required imaging modalities involving ionizing radiation. Similar approach and formula[7] were used to estimate the minimum number of request forms for review as 177. A field was taken as completed when a date was written in the field meant for LMP. A blank field was assigned zero (0) score while a completed field was assigned a score of one (1).

Data obtained from the review and completed questionnires were then analysed using computer software, SPSS version 23. Categorical data was analyzed using frequencies and percentages. Chi square (χ^2) was used to determine significant associations between categorical variables.

Ethical approval for this study was obtained from the Ethics Review Committee of the Aminu Kano Teaching Hospital with the approval numbers NHREC/21/08/2008/AKTH/EC/2045 and AKTH/MAC/SUB/12A/P-3/VI/2145. Informed consent was obtained from all study participants with full compliance the principles of Helsinki Declaration.

Results

Demographics of Respondents

Two hundred and two questionnaires were administered to respondents and one hundred and ninety-three were returned. This indicated a 96% response rate which is considered an excellent response rate and sufficiently representative for the analysis.

Of the respondents, 133 (69%) were males, while 60 (31%) were females.

Table 1 : Distribution of respondents' Qualification

Cadre/Specialty	Number	Percentage
Consultant	17	8.8
Registrar	75	38.9
Medical officer	33	17.1
Intern	18	9.3
Radiologist	10	5.2
Radiographer	15	7.8
Physiotherapist	25	13.0
Total	193	100.0

Table1 indicates that over a third of the respondents were registrars making up 38.9% of respondents, 17.1% were Medical officers, Physiotherapists constituted 13% of the respondents' distribution, the Interns involved in the study consisted of 9.3%. Also 8.8% of the respondents were Consultants, 7.8% of the respondents were Radiographers while the least proportion, 5.2% were Radiologists.

Most 140 (73%) of the respondents have working experience of three years and above, 33 (17%) of the respondents were on internship, and respondents with less than three years of service constituted only 20 (10%) of the respondents.

Table 2 revealed the knowledge of respondents on estimated fetal doses from some conventional X-ray imaging modalities, thus on Chest X-ray, more than average 55% of the respondents gave right answer of the estimated fetal doses, 24% of the respondents gave under estimated fetal doses, 6% over estimated doses.

However, 55% of respondents underestimated fetal doses from Abdominal X-ray, respondents with the right Knowledge of doses of Abdominal X-ray constituted 27% of the distribution, 6% of the respondents overestimated the doses.

Also on Barium enema 46% underestimated fetal doses given, 21% indicated appropriate estimated fetal doses from barium enema, and 17% of the respondents overestimated the doses from Barium enema, while respondents with no idea of estimated fetal doses constituted 16% of distribution.

Meanwhile, respondents with the right knowledge of estimated fetal doses Abdominal CT consisted of 19% of the distribution, an average 50% of the respondents overestimated the doses for Abdominal CT, 24% of the respondents indicated an underestimation in doses given for Abdominal CT, leaving 7% of the respondents indicating that they have no knowledge of the estimated fetal doses for Abdominal CT.

Furthermore, 31% of the respondents suggested right estimation of doses from Urography, 42% of the respondents' underestimated doses received during Urography, 10% of the respondents overestimated the doses, while 16% of the respondents indicated that they have no knowledge of the estimated fetal doses for Urography.

Respondents with the right estimation of doses for Chest CT constituted 27% of the distribution, 47% of the respondents suggested underestimation of doses for Chest CT, 12% overestimated the doses and 14% respondents ascribed no knowledge of estimated fetal doses for Chest CT.

Table 2: Respondents' Knowledge of Radiation Doses

	Under estimation, n(%)	Right answer, n(%)	Overestimation n(%)	Not indicated, n(%)	Total n(%)
Chest X-ray	47 (24.4)	107 (55.4)	12 (6.2)	27 (14.0)	193 (100.0)
Abdominal X-ray	106 (54.9)	52 (26.9)	12 (6.2)	23 (11.9)	193 (100.0)
Barium enema	89 (46.1)	40 (20.7)	33 (17.1)	31 (16.1)	193 (100.0)
Abdominal CT	46 (23.8)	37 (19.2)	96 (49.7)	14 (7.3)	193 (100.0)
Urography	82 (42.5)	60 (31.1)	20 (10.4)	31 (16.1)	193 (100.0)
Chest CT	90 (46.6)	53 (27.5)	23 (11.9)	27 (14.0)	193 (100.0)

Table 3: Respondents' Knowledge on Guidelines that state when and how to screen for pregnancy (Multiple responses are possible)

Knowledge of rules on screening for pregnancy	Frequency	%
Knowledge of existing guideline on when and how to screen for pregnancy	70	36.3%
Verbally asking patients pregnancy status	150	78.9%
The 10 day rule	8	4.2%
The 28 day rule	31	16.3%
Last child birth	11	5.8%
Last menstrual period	186	97.9%
Notices placed in imaging rooms	20	10.5%

Table 3 depicts that 36% of the respondents indicated that they have Knowledge of an existing guideline on when and how to screen for pregnancy; this implies that more than average of the respondents have no Knowledge of existing guidelines on when and how to screen for pregnancy.

About 79% of the respondents indicated they have knowledge of verbally asking patients' pregnancy status as a means of screening for pregnancy. While majority, 97.9% of respondents know of the use of last menstrual period as means of screening for pregnancy.

Meanwhile less than 4.2% of the respondents revealed having knowledge of the 10 day rule, 16.3% the 28 day rule, 5.8% last child birth as means of ruling out pregnancy prior to requesting for radiation exams that require ionizing radiation. Only 10.5% know that screening could be done through notices placed in imaging rooms that urged the patient to indicate if there was a possibility of them being pregnant, as a means to screen for pregnancy.

Table 4: Results from Review of Radiological Request forms that Utilize X-rays in Women of Reproductive Age Group

Record of last menstrual period	Frequency	%
Not written	148	83.6
Written	29	16.4
Total	177	100.0

Review of radiological request forms that Utilize X-rays in Women of Reproductive Age Group shows that in majority of the patients, 148 (84%) out of the 177 forms reviewed, the LMP was not indicated (Table 4).

From review of the request forms, it can be seen that more than average 84% of the request forms did not have the last menstrual period documented, while only 16% had the last menstrual period documented despite the patients being in the reproductive age group. This Implies that priority is not placed on recording last menstrual period as revealed by this study.

Table 5: Relationship between Respondents' Knowledge on radiation doses and respondents' years of practice

	Years of Practice	Intern n(%)	<3years n(%)	>3years n(%)	Total n(%)
Knowledge of Radiation doses	Under estimation	7(12.3)	4(7.0)	46(80.7)	57(100.0)
	Right answer	13(13.8)	10(10.6)	71(75.5)	94(100.0)
	Over estimation	7(25.0)	6(21.4)	15(53.6)	28(100.0)
	Does not know	6(42.9)	0(0.0)	8(57.1)	14(100.0)
	Total	33	20	140	193

χ^2 Value= 16.68, P-value =0.016

Table 5 depicts that there is no statistically significant relationship between respondents' knowledge of radiation doses and respondents' years of practice, since the obtained p-value (0.016) is >0.01 for 99% confidence limit.

Table 6: Relationship between respondents Knowledge on guideline on when/how to screen for pregnancy and years of practice of respondents

	Years of Pracitice	Intern n(%)	<3years n(%)	>3years n(%)	Total n(%)
Knowledge of existing guideline on when and how to screen for pregnancy	Yes	9(12.9)	7(10.0)	54(77.1)	70(100.0)
	No	24(19.5)	13(10.6)	86(69.9)	123(100.0)
	Total	33	20	140	193

χ^2= 1.49, p-value=0.475

Table 6 shows that there is no relationship between the between knowledge on guideline on when/how to screen for pregnancy and years of service of respondents, since p> 0.01 level of significance.

Discussion

The radiation dose of chest X-ray was the most correctly estimated by majority of our respondents. The most underestimated was the fetal dose received during abdominal X-ray, the doses of barium enema, Urography and chest CT were also underestimated. The dose from abdominal CT was the most over estimated by the respondents. An earlier study [12] also evaluated the knowledge of patient radiation exposure from diagnostic imaging requested in the emergency department, they found out that emergency doctors from the sample had varied knowledge but overall, it was poor and the radiation doses are underestimated. Underestimation of the actual dose might lead referring healthcare workers to request radiological examinations more often than is necessary.

Based on this study, there is no relationship between respondents' knowledge of radiation doses and respondents' duration of practice. This is an unexpected finding as years of practice is expected to come additional experience and corrections from senior colleagues.

Knowledge of risk from in-utero exposure

From our results, only 20% of respondents suggested that the risk begins at 10mGy while 62% of the respondents overestimated the fetal dose at which risk of malignancy begins. Previous studies have suggested the risk of malignancy to begin at dose of 10mGy such as that found in a study in Australia[11] which stated that adverse effects have been statistically proven at the dose levels associated with diagnostic radiation procedures as very small increase in childhood malignancy with an estimated increase in 1 additional cancer deaths per 1700 from 10mGy exposures[11].

Majority of the respondents revealed that the time interval during which the total amount of radiation was received has influence on the risk for cancer development, while others suggested the time interval during which the total amount of radiation received does not influence the risk of malignancy development implying sub-optimal knowledge about the time spacing implications of the radition dose.

Majority of the respondents in our own study suggested that 8-15 weeks is the gestational age at which the developing fetus is most sensitive to ionizing radiation. Existing literature shows that risks are less in fetuses that are less than 2 weeks or more than 15 weeks of gestational age and that fetuses between 2 -15 weeks are considered more sensitive to adverse radiation effects[14]. The sensitivity is highest 8-15 weeks post conception[4] as organogenesis occurs during this period.

Regarding how and when to screen for pregnancy, our findings showed that the use of 10 day rule, 28 day rule, last child birth and notices were not widely known by the respondents. Majority of respondents indicated knowing the use of last menstrual period as a means of screening for pregnancy. Despite this knowledge, this study shows that only 16% of the radiological forms reviewed had the column for last menstrual period documented and the patients were all within the reproductive age group. This shows a poor compliance with the guidelines and is consistent with a study done in Nigeria where only 11.5% of request forms had the column for last menstrual period documented [18].

This study found that there is no relationship between the knowledge of guidelines on when and how to screen for pregnancy and the years of service of respondents. This is probably because the training on use of these guidelines occur pre-service (i.e when the staff where in health training institutions). Generally for examinations that deliver low radiation dose to the uterus, that is, non-contrast x rays of the abdomen and chest, the “28 Day rule” is applied; while the “10 Day Rule' is applicable to relatively high does examinations (>10mGy to the fetus) such as in pelvic, abdominal CT and diagnostic fluoroscopy of the abdomen and pelvis such as barium enema[1]. And it has been recommended that notices regarding pregnancy should be posted in patient waiting areas, such as; *“If it is possible that you might be pregnant, notify the physician or other staff before your x-ray examination, treatment, or before being injected with a radioactive material as means of prevention and minimization of risks”.*[17]

It is therefore recommended that radiological safety courses, for example during Continuing Professional Development Programs and in-house seminars would be useful in decreasing the number of unsafe radiological investiagtions. Radiation doses and their fetal equivalent doses should be shown in these courses and staff moniitored as they balance balance risks and benefits during day to to day work.

It is also recommended that periodic audit of both patients files and requests forms should form part of the hospital regular morbidity and mortality audits.

Conclusion

Most of the respondents underestimated the fetal doses from radiographic imaging based on imaging modality and body, showing presence of high risk to patients. The finding that longer duration in practice affects does not affect safeguards implies that more systematic measures involving both didactic and on the job training are required for all categories of staff.

There was variability in the knowledge of healthcare workers regarding guidelines that state when and how to screen for pregnancy. Majority however had knowledge of use of Last Menstrual Period (LMP) as a screening modality. Despite this knowledge, the compliance with these guidelines was very poor when triangulated with the reviewed request forms for radiological exams done in women within the reproductive age group containing the last menstrual period of the patients. We recommend that all radiologic facilities should have a process to assist in identifying whether women of child bearing age so that both maternal and fetal risks will be reduced.

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