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Awareness of patients on ionizing radiation exposure and the risks associated with it in CT scan examination at Moi teaching and referral hospital, Kenya

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Abstract

Background: Computer Tomography (CT) scan utilizes ionizing radiation that has been established as risk factors for development of cancer. However, patients' knowledge of these risks is not well documented and especially in Kenya. **Objective:** To establish patients' awareness on ionizing radiation exposure and the risks associated with repeated CT scan examination. **Methods:** A prospective study carried out in Moi Teaching and Referral Hospital (MTRH). It was descriptive cross-sectional study. Convenient sampling method was used to get a sample size was 120 patients. The data was collected using structured questionnaires and analysed. The study was conducted between April and June 2019. **Results:** A total of 120 participants were recruited into the study of which 60% were male and 40% female. Majority (38%) had secondary level of education. Overall, 18% were familiar with the term ionizing radiation, 14% knew that CT scan uses ionizing radiation but only 2% were aware that CT scan emits higher ionizing radiation as compared to the general X-rays. At the same time, 65% knew that ionizing radiation posed greater risk to pregnant women. In addition, 10% were aware of the relationship between ionizing radiation exposure and development of cancer. Separately, 63% were aware and observed some of the safety practices in a CT scan unit. **Conclusion:** Majority of the patients seen at the MTRH CT scan unit did not demonstrate an understanding of the concept of ionizing radiation exposure and the risk associated with multiple CT scans examinations.

Keywords: Ionizing radiation, Awareness of ionizing radiation exposure, Risks associated, Multiple CT Scan examination.

INTRODUCTION

In recent years, studies have documented increasing patient radiation exposures, which can be attributed to increased utilization of diagnostic imaging studies, particularly Computed Tomography (CT). In a previous study, CT has been shown to account for merely 6% of diagnostic procedures, yet represents 47% of the entire radiation exposure received by patients (Hart & Wall, 2004) [1]. Furthermore, the number of referrals for paediatric CT scans has increased exponentially (Brenner, et al. 2001) [2].

Not surprisingly, concerns are growing over the risks associated with these high levels of exposure, particularly the potential increased lifetime risk of cancer. The cancer causing biological effects of ionizing radiation, including low doses received during medical diagnostic imaging, are well documented (Brenner, D et al. 2007) [3].

Despite such increasing utilization of radiation in medical imaging, awareness among patients on radiation exposure during CT scan and the associated cancer risk is yet to be thoroughly investigated.

In Kenya, and at Moi Teaching and Referral Hospital (MTRH) to be more specific, the current level of awareness of patients on radiation dose and risks associated with CT scan is not well-documented in the literature despite increasing utilization of the modality in medical imaging.

The study aimed at determining the level of awareness of patients on ionizing radiation exposure during CT scan and the associated risks. Establishing this is greatly significant as it will help the hospital create awareness of the potential risks of ionizing radiation exposure among patients, patients' families,

referring physicians, and radiographers. This helps in ensuring effective patient consent and avoiding unnecessary CT scan exposure.

Awareness of patients on ionizing radiation exposure during CT scan is generally poor. A study by the Royal Australian and New Zealand College of radiologists, which aimed at assessing awareness of radiation exposure with different imaging modalities among patients, showed that 32 percent of the study sample felt that CT scans have nil to very small amounts of radiation (Markowsky & Peduto, 2012) [11]. In Australia still, a study conducted in a private radiology unit, only a third of the participants correctly reported that CT has a higher radiation dose than x-ray (Singha, Mohacsy, & Connell, 2016) [13].

A study done in Saudi Arabia by Haider (2011) [8] revealed that majority of patients (82%) were not aware of the radiation exposure during a CT scan. The study also revealed that about two thirds of the respondents (63%) had not been informed about risk from CT radiation by referring physician, radiologist nor the operator in CT unit (Haider Najim Aubaid, 2011) [8].

Many patients are not familiar with radiation risks at all and when interviewed expressed concern that they should be informed of any harm that comes as a result of the radiological procedures (Thomas E. Robey, 2014) [14]. According to a study done by European Society of Radiology in 2015, there is little awareness among patients about radiation risks caused by use of CT and there is need to improve patient knowledge in order to protect them from increasing lifetime cancer risk. A study by Replinger M.D. in the United States of America revealed that minority of patients (14.1%) understand the relative radiation exposure of a CT scan compared with a chest x-ray.

At the same time, about a quarter of the respondents (25.6%) believed there was an increased risk of developing cancer from repeated abdominal CT scans. The study also associated higher education levels to correct responses, although even within the well-educated respondents, a significant majority gave an incorrect response to all questions (Michael D. Replinger, Annabel J. Li, James E. Svenson, & William J. Ehlenbach, 2016) [12].

In Kenya, the current level of awareness of patients on radiation exposure and the associated risks is not well documented in the literature. However, a recent study carried out at Kenyatta National Hospital (KNH) revealed that health workers lack basic knowledge on ionizing radiation doses and its harmful effects which impacts negatively on their attitude and practice (Gekaga, 2013) [7]. The implications here are serious for the patients as they are possibly being exposed to unnecessary radiation, which could increase their risk of carcinogenesis. At Moi Teaching and Referral Hospital (MTRH), the level of awareness of ionizing radiation dose among the patients is not well documented.

Patient radiation safety entails protection of patient from excessive radiation doses and minimizing frequency of exposure to ionizing radiations. Patient awareness on radiation safety is necessary in order to minimize lifetime risk of cancer due to exposure to unnecessary radiation. However the level of awareness on radiation safety among patients is generally poor. According to a cross-sectional study done in 18 hospitals of Shahid Beheshti University of Medical Sciences in Iran, it was found out that radiation safety awareness among patients was particularly poor (Ali, Mohammad, Arash, Mansour, & Ali, 2014) [1]. Another cross sectional study done in three hospitals in Port Harcourt (2013) also established many patients were not aware of radiation safety measures (Briggs-Kamara M., Okoye P., Omubo-Pepple V., 2013) [4]. Patients should be educated so that they understand the safe use of radiation, and to become more active participants in their own healthcare (Mark, 2011) [10].

MATERIALS AND METHODS

This was cross-sectional descriptive study. The study site was the radiology unit of Moi Teaching and Referral Hospital (MTRH), Kenya. The target population were patients sent for CT scan at the radiology unit

of this hospital. The study was conducted from 1st April to June 30th, 2019.

In the study, convenient sampling was employed. This was because our target population was specifically patients undergoing CT scan at the radiology unit of MTRH. The sample size was calculated and a sample size of 120 was arrived at.

All patients seen at MTRH, CT scan unit, who were 18 years and above were included in the study. Patients who were severely ill or unwilling to participate in the study were excluded. A research questionnaire was used as a data collection tool. Microsoft Excel was used for processing data based on the study. Mixed methods were used to analyse this data.

The research proposal was submitted and approved by the Institutional Research and Ethics Committee. Consent was sought from the respondents before data collection. Confidentiality and

anonymity was assured and ensured for all the respondents who took part in the study. Patients had the right to withdraw from the study at any time.

RESULTS

The age groups and gender of the respondents were distributed as follows:

Table 1: Age of the Respondents

Age	Number of respondents	Percentage
18-30	25	21
31-40	29	24
41-50	27	23
51-60	20	17
>60	19	16

The age distribution of the respondents was quite balanced through the five age groups that were within the inclusion criteria, with the largest age group being 31-40years at 24%, while the lowest were those above 60 years at 16%.

The male were 72 (60%) while the female were 48 (40%).

Table 2: Gender of the Respondents

Male	72	60%
Female	48	40%
Total	120	

Level of education

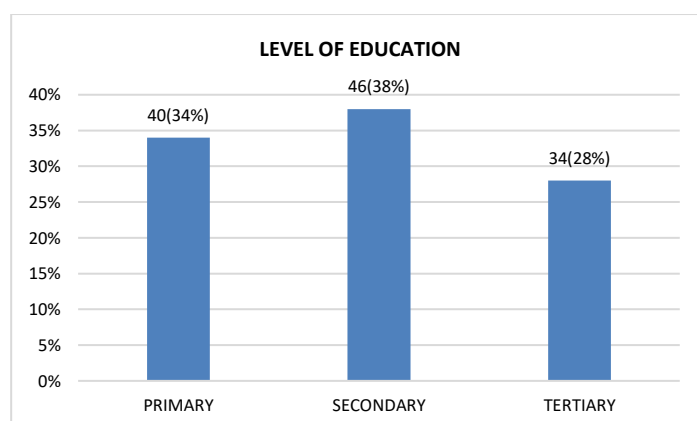


Figure 1: Level of Education of the Respondents

Majority of the respondents had attained secondary level of education (38%) while 34% had attained primary level. The remaining 28% had attained tertiary level of education.

Anatomical sites where CT scan requisition was made

The anatomical areas where CT scan was to be performed according to the requisition for the patients interviewed was as follows:

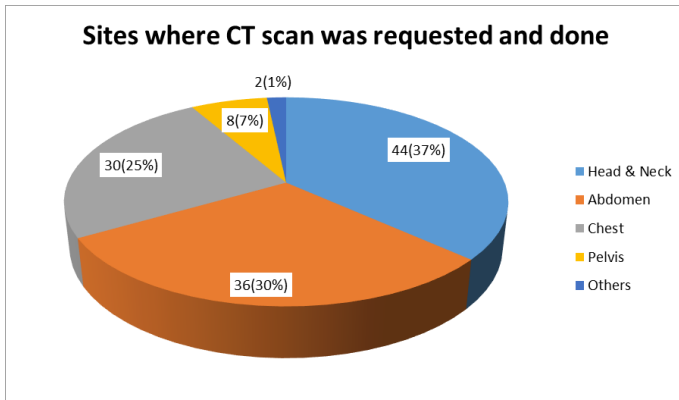


Figure 3: Anatomical areas where CT scan was requested and done

Majority of the patients seen 37% (n=44) underwent head and neck CT scan. A closer proportion (30%) underwent abdominal scan while 25% underwent chest scans. The least seen scans were pelvic (7%) and others which were at 1%.

A total of 72(60%) patients reported to have undergone prior imaging procedures while 40% (n=48) had not. Majority of the respondents had previous imaging procedures which included chest x-ray at 45% and CT scan at 55%. All respondents were aware of the fact that CT scan helps in providing images of internal organs.

Only 14% (n=16) of our respondents were aware that CT scan uses ionizing radiation while 86% (n=104) had no knowledge of use of ionizing radiation during CT scan examination.

There were 3 patients (2.5%) who were aware that CT scan examination emits a higher ionizing radiation than General X-rays for similar examination. 97.5 % (n=117) of these patients were not aware. A total of 46 of the 120 respondents were aware of the fact that exposure of a pregnant woman to ionizing radiation posed a risk to the developing foetus. Majority (78) of the respondents (65%) were not aware of the risk posed by ionizing radiation to a developing foetus.

Of the total respondents, 12 knew that there is a relationship between ionizing radiation and cancer, while the remaining 108 did not know. This implies that majority of the patients (90%) were not aware of any risk relationship between multiple CT scan examinations and cancer development.

Among the respondents, 63% (n=76) were aware of at least one of the safety measures undertaken at a CT scan room in order to minimize ionizing radiation.

Out of 120, 116 respondents, who represent 96%, were not familiar with the 'Radiation' sign.

DISCUSSION

The age distribution of the respondents ranged from 18 years to over 60 years. In terms of gender, there were slightly more male than the female respondents. Majority of the respondents were married.

The level of education had an influence on the knowledge about radiation risks and safety measure, although this was not the case throughout.

The study showed that majority of the patients seen at the CT scan unit were referred for CT head and neck examination. This was closely followed by CT scan abdomen and chest examinations. Most of the cases were attributed to head trauma, which is common due to our mode of transport which commonly involves motor cycle transport. There are also brain infections and tumour related complications which are commonly seen.

Majority of the respondents had previous imaging procedures which included chest x-ray (45%), CT scan (55%). This was an indication that majority of the patients had undergone ionizing radiation exposure more than once in a time span of 5 years. Although all the respondents were aware of the fact that CT scan helps in providing images of internal organs, 34% of them were not aware that CT scan uses ionizing radiation. In fact, only 25% of the respondents were aware of the term ionizing radiation, which was perhaps due to the question having multiple choices. This implies that they had an idea as to what ionizing radiation was but did not have a full understanding of the concept. This was further evident as only 14% of the respondents were aware that CT scan uses ionizing radiation.

Notably still, majority of the patients (98%) were not aware that CT scan has a higher ionizing radiation exposure as compared to the general X-rays for a similar examination like CT scan chest and Chest X-ray. This included those who had history of prior exposure to X-rays and CT scans. This clearly indicates that there is a gap in terms of patient education and knowledge of the various radiological procedures they undergo.

Majority of the respondents 65% (n=78) were not aware of the risk posed by ionizing radiation to a developing foetus. It has indeed been shown that foetal organs are particularly sensitive to ionizing radiation during their early development. The health consequences can be severe and include stunted growth, deformities, abnormal brain function and cancer that may develop later in life.

The study established that majority of the patients (65%) were not aware of any risk relationship between multiple CT scan exposure and cancer development. Perhaps not surprisingly, there was a significant relationship between answering questions correctly and having at least a secondary level of education. However, most patients in these categories still did not demonstrate an understanding of the concept of ionizing radiation and its downstream effects as far as induction of cancer is concerned. This builds upon the findings reported previously. For instance, a study by Michael Repplinger *et al.* in 2016 [12] reported that only a quarter of the respondents believed there was an increased risk of developing cancer from repeated abdominal CT scans (Michael D. Repplinger, Annabel J. Li, James E. Svenson, & William J. Ehlenbach, 2016) [12].

The study also associated higher education levels to correct responses, and established that even among the well-educated respondents, majority gave incorrect responses. This is despite the fact that the cancer causing biological effects of ionizing radiation, including low doses received during medical diagnostic imaging, are well documented (Brenner, D; Hall, E; Phil, D, 2007) [3].

Based on epidemiologic data, the radiation exposure of one abdominopelvic CT, which is approximately 10 mSv, confers an estimated 1:2000 risk of developing cancer. Brenner and Hall (2007) [3] estimated that approximately 2% of all cases of cancer in 2007 in the United States were caused by medical imaging (Brenner, D; Hall, E; Phil, D, 2007) [3].

Among the respondents, 63% proved to be aware of at least one of the safety measures undertaken at a CT scan room. The respondents who were aware responded of the exclusivity of the CT scan area (not being accessible to everyone). They also reported observing the staff wearing protective gear within the CT scan room. However, this was in respect to patients who had already undergone a CT scan. The remaining 37% of respondents were not aware of any safety regulations. This compares well with a study done in Port Harcourt, Nigeria, which found that only 25% of the patient respondents knew about the use of protective devices during

the use of CT scan (Briggs-Kamara M., Okoye P., Omubo-Pepple V., 2013) [4].

However, 96% of the respondents were not familiar with the radiation warning sign. There is currently no specific study on awareness of the radiation warning signs but the level of awareness on radiation safety among patients is generally poor. According to a cross-sectional study done in 18 hospitals of Shahid Beheshti University of Medical Sciences in Iran (2014), it was found out that radiation safety awareness among patients was less than (Ali, Mohammad, Arash, Mansour, & Ali, 2014) [1].

The understanding of the radiation warning sign is important to ensure that the patients do not get close to the radiation source or zone and this ensures safety.

CONCLUSION

Majority of the patients, 86% (n=104) had no knowledge that CT scan emits and utilizes ionizing radiation during an examination. Majority of these patients seen at the Moi Teaching and Referral Hospital (MTRH) CT scan unit did not demonstrate an understanding of the concept of ionizing radiation exposure and the associated risk with repeated CT scan imaging. Moreover, 97.5% (n=117) of these patients did not understand that CT scan emits a higher ionizing radiation exposure as compared to the general X-rays for similar examinations. They equally did not demonstrate an understanding of the increased risk for developing cancer over one's lifetime with multiple exposures to ionizing radiation. Factors associated with improved understanding were higher education and previous CT scan exposure. There was a significant gap on the adequacy of shared information and informed decision-making as far as the use of medical imaging modalities that emit ionizing radiation is concerned.

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