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Original Research Article

Knowledge and Awareness of Radiation Exposure and Safety Practices among Patients Undergoing Medical Imaging

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Abstract

Background: Medical imaging procedures involving ionizing radiation are widely used for diagnosis and management, but they carry potential health risks if not properly understood and managed.
Aim: To assess the knowledge and awareness of radiation exposure and safety practices among patients undergoing medical imaging.
Methods: A hospital-based cross-sectional study was conducted among 150 patients using a structured questionnaire. Data were analyzed using SPSS, and associations were tested using the Chi-square test with $p < 0.05$ considered significant.
Results: Only 29.3% of patients had good knowledge, while 42.0% and 28.7% had moderate and poor knowledge respectively. Awareness regarding CT radiation was 65.3%, while only 38.0% were aware of X-ray exposure and 32.7% knew about cancer risk. Significant association was found between education and knowledge ($p = 0.002$). Awareness of safety practices such as lead apron use (48.0%) and dose minimization (36.0%) was limited.
Conclusion: Knowledge and awareness of radiation exposure and safety practices among patients are inadequate, highlighting the need for improved education and communication strategies in healthcare settings.

Keywords: Radiation exposure, Awareness, Medical imaging, Patient safety.
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Introduction

Medical imaging plays a pivotal role in modern healthcare, enabling accurate diagnosis, disease monitoring, and therapeutic planning. Modalities such as X-rays, computed tomography (CT), fluoroscopy, and nuclear imaging rely on ionizing radiation, which, although clinically indispensable, poses potential health risks due to cumulative radiation exposure [1]. With the increasing utilization of imaging procedures worldwide, concerns regarding radiation-induced effects, including carcinogenesis and tissue damage, have become more prominent, particularly in patients undergoing repeated imaging examinations [2].

Ionizing radiation exposure in medical settings has significantly increased over the past few decades, with millions of imaging procedures performed annually. Studies have shown that computed tomography, although constituting a smaller proportion of imaging procedures, contributes disproportionately to the overall radiation dose received by patients [2]. This growing exposure highlights the importance of radiation protection principles, such as justification, optimization, and dose limitation, to minimize unnecessary radiation risks [3].

Patient awareness and understanding of radiation exposure are critical components of safe medical imaging practices. Adequate knowledge enables patients to make informed decisions, enhances compliance with diagnostic procedures, and promotes shared decision-making between healthcare providers and patients. However, several studies have reported that patients generally have limited knowledge regarding radiation risks, doses, and protective measures associated with medical imaging [4]. Recent cross-sectional studies have

demonstrated that only a small proportion of patients possess adequate knowledge about radiation hazards, with many underestimating the risks associated with commonly used imaging modalities. For instance, studies conducted among patients undergoing diagnostic imaging have reported that less than one-third of participants were aware of radiation-related risks, and awareness was significantly associated with factors such as educational level and prior exposure to imaging procedures [5].

In addition to knowledge gaps, misconceptions about radiation safety practices are also prevalent among patients. Many individuals are unaware of the protective measures implemented during imaging procedures, such as the use of lead shielding, dose optimization techniques, and adherence to safety guidelines. This lack of awareness may lead to anxiety, poor compliance, or unnecessary repetition of imaging studies, thereby increasing cumulative radiation exposure [6].

The role of healthcare professionals in educating patients about radiation exposure and safety practices is crucial. Effective communication regarding the benefits and risks of imaging procedures can significantly improve patient understanding and reduce unnecessary fear. Furthermore, international initiatives such as radiation safety campaigns emphasize the need for patient-centered education to enhance awareness and promote safe imaging practices [7].

Studies assessing awareness among healthcare providers have also revealed suboptimal knowledge levels regarding radiation protection, which may indirectly influence patient education. This underscores the need for continuous training programs and awareness initiatives not only for healthcare professionals but also for patients to ensure safe and rational use of diagnostic imaging [8].

The concept of radiation safety is further reinforced by global recommendations advocating the implementation of the “As Low As Reasonably Achievable” (ALARA) principle, which aims to minimize radiation exposure without compromising diagnostic quality. Adherence to such principles requires both healthcare providers and patients to be adequately informed about radiation risks and safety measures [3,9].

Given the increasing dependence on medical imaging and the associated risks of radiation exposure, assessing patient knowledge and awareness is essential to identify gaps and develop targeted educational interventions. Understanding patient perspectives can contribute to improved safety practices, optimized use of imaging modalities, and reduction of unnecessary radiation exposure [10]. Therefore, the present study aims to evaluate the knowledge and awareness of radiation exposure and safety practices among patients undergoing medical imaging, thereby providing insights into existing knowledge gaps and facilitating the development of strategies to enhance patient education and safety.

Material and Methods

The present study was conducted as a hospital-based cross-sectional observational study in the Department of Radiology of a tertiary care hospital over a defined study period after obtaining necessary institutional permissions. A total of 150 patients undergoing medical imaging procedures were included in the study.

Patients aged 18 years and above who were referred for diagnostic imaging procedures such as X-ray, computed tomography (CT), or other radiological investigations involving ionizing radiation were included. Patients who were critically ill, unwilling to participate, or unable to comprehend the questionnaire were excluded from the study.

Data were collected using a structured and prevalidated questionnaire designed to assess the knowledge and awareness of radiation exposure and safety practices among patients. The questionnaire consisted of sections covering demographic details such as age, gender, and educational status, as well as questions related to awareness of radiation risks, knowledge of radiation exposure from imaging modalities, and understanding of safety practices such as use of protective shielding and dose minimization. The questionnaire was explained to participants in a language they could understand, and responses were recorded accordingly.

Prior to data collection, a pilot study was conducted on a small subset of participants to assess the clarity and reliability of the questionnaire, and necessary modifications were made. The final questionnaire was administered to all 150 participants either through direct interview or self-administration under supervision.

The collected data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software version 25.0. Descriptive statistics such as frequencies and percentages were used to summarize categorical variables, while mean and standard deviation were calculated for continuous variables. The level of knowledge and awareness was categorized based on scoring criteria derived from questionnaire responses.

Inferential statistical analysis was performed to assess the association between demographic

variables and levels of knowledge and awareness. The Chi-square test was used for comparison of categorical variables, and a p-value of less than 0.05 was considered statistically significant. Where applicable, correlation analysis was performed to evaluate relationships between knowledge scores and demographic factors.

Ethical clearance for the study was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was obtained from all participants after explaining the purpose of the study. Confidentiality and anonymity of the participants were strictly maintained throughout the study, and participation was entirely voluntary.

Results

Table 1 shows the demographic distribution of the study participants. Out of 150 patients, the majority belonged to the age group of 31–45 years (52 patients, 34.7%), followed by 18–30 years (41 patients, 27.3%), 46–60 years (38 patients, 25.3%), and above 60 years (19 patients, 12.7%). Males constituted 82 patients (54.7%), while females were 68 (45.3%). In terms of educational status, 48 patients (32.0%) had primary education, 56 (37.3%) had secondary education, and 46 (30.7%) had higher education.

Table 2 illustrates the level of knowledge regarding radiation exposure among patients. Only 44 patients (29.3%) demonstrated good knowledge, 63 (42.0%) had moderate knowledge, and 43 (28.7%) had poor knowledge. This indicates that nearly 70.7% of patients had inadequate to moderate understanding of radiation exposure, highlighting a significant knowledge gap.

Table 3 depicts awareness of radiation risks associated with different imaging modalities. While 98 patients (65.3%) were aware that CT scans involve higher radiation exposure, only 57 patients (38.0%) were aware of radiation exposure from X-rays. Additionally, only 49 patients (32.7%) knew that repeated imaging could increase cancer risk, indicating limited awareness regarding long-term effects.

Table 4 shows awareness of radiation safety practices among participants. A total of 72 patients (48.0%) were aware of the use of lead aprons for protection, while only 54 (36.0%) were aware of dose minimization techniques. Furthermore, only 46 patients (30.7%) reported that they had ever been informed about radiation risks by healthcare professionals, suggesting inadequate patient education. Table 5 demonstrates the association between educational status and level of knowledge regarding radiation exposure. Among patients with higher education, 28 (60.9%) had good knowledge compared to only 6 (12.5%) among those with primary education. This association was found to be statistically significant ($p = 0.002$), indicating that education plays a crucial role in improving awareness and knowledge of radiation safety.

Table 1: Demographic distribution of study participants (n = 150)

Variable	Category	Frequency	Percentage (%)
Age Group	18–30 years	41	27.3%
	31–45 years	52	34.7%
	46–60 years	38	25.3%
	>60 years	19	12.7%
Gender	Male	82	54.7%
	Female	68	45.3%
Education	Primary	48	32.0%
	Secondary	56	37.3%
	Higher	46	30.7%

Table 2: Level of knowledge regarding radiation exposure (n = 150)

Knowledge Level	Frequency	Percentage (%)
Good	44	29.3%
Moderate	63	42.0%
Poor	43	28.7%
Total	150	100%

Table 3: Awareness of radiation risks in imaging modalities (n = 150)

Parameter	Yes	No	Percentage Aware (%)
CT scan has high radiation	98	52	65.3%
X-ray involves radiation	57	93	38.0%
Repeated exposure increases cancer risk	49	101	32.7%

Table 4: Awareness of radiation safety practices (n = 150)

Parameter	Yes	No	Percentage Aware (%)
Use of lead apron	72	78	48.0%
Dose minimization awareness	54	96	36.0%
Informed by healthcare professional	46	104	30.7%

Table 5: Association between education and knowledge level (n = 150)

Education Level	Good	Moderate	Poor	Total
Primary	6	20	22	48
Secondary	10	28	18	56
Higher	28	15	3	46
Total	44	63	43	150

Discussion

The present study evaluated the knowledge and awareness of radiation exposure and safety practices among patients undergoing medical imaging and revealed considerable gaps in patient understanding despite the widespread use of diagnostic imaging modalities. The overall distribution showed that only 29.3% of participants had good knowledge, while a majority of 70.7% demonstrated moderate to poor knowledge. These findings are consistent with recent studies that have reported suboptimal awareness levels among patients, suggesting that patient education regarding radiation exposure remains inadequate in clinical settings [11].

Age-wise distribution indicated that the majority of participants were in the 31–45 years age group (34.7%), followed by 18–30 years (27.3%). Although younger and middle-aged individuals formed a significant proportion of the study population, knowledge levels were not proportionately high, indicating that age alone does not significantly influence awareness. Similar observations have been reported in recent cross-sectional studies where awareness of radiation risks was found to be uniformly low across different age groups, highlighting the need for structured educational interventions [12].

Gender distribution showed that males (54.7%) slightly outnumbered females (45.3%), but no major difference in knowledge levels was observed between the two groups. This suggests that gender may not be a significant determinant of awareness, which is in agreement with recent literature indicating that knowledge of radiation exposure is more closely associated with educational background rather than gender differences [11,13].

A key finding of the present study was the significant association between educational status and knowledge level ($p = 0.002$). Among patients with higher education, 60.9% demonstrated good knowledge compared to only 12.5% among those with primary education. This clearly indicates that education plays a critical role in enhancing patient awareness regarding radiation risks and safety practices. Similar findings have been reported in recent studies where educational attainment was identified as one of the strongest predictors of radiation awareness [13,14]. Awareness regarding radiation risks associated with imaging modalities was found to be variable. While 65.3% of patients were aware that CT scans involve higher radiation exposure, only 38.0% were aware that X-rays also involve radiation. Furthermore, only 32.7% of participants were aware that repeated exposure could increase the risk of cancer. These findings highlight a significant gap in understanding the cumulative effects of radiation exposure. Comparable studies have reported similar trends, where patients tend to underestimate radiation exposure from commonly used diagnostic tools, thereby increasing the risk of repeated and unnecessary imaging procedures [12,15].

The awareness of radiation safety practices was also found to be inadequate. Only 48.0% of participants were aware of the use of lead aprons, and 36.0% were aware of dose minimization techniques. Notably, only 30.7% of patients reported receiving any information about radiation risks from healthcare professionals. This indicates a lack of effective communication between healthcare providers and patients regarding radiation safety. Previous studies have emphasized that healthcare professionals play a vital role in patient education and that improved communication can significantly enhance patient awareness and reduce anxiety related to imaging procedures [14,15].

Overall, the findings of the present study underscore the need for increased patient education and awareness programs focusing on radiation exposure and safety practices. Implementation of structured counseling, educational materials, and awareness campaigns in healthcare settings can significantly improve patient knowledge and promote safer use of diagnostic imaging. The integration of patient education into routine clinical practice is essential to ensure informed decision-making and adherence to radiation safety principles [11–15].

Conclusion

The present study concludes that knowledge and awareness of radiation exposure and safety practices among patients undergoing medical imaging are generally inadequate, with only a small proportion demonstrating good knowledge. Educational status was found to be significantly associated with awareness levels, indicating that targeted educational interventions are necessary.

Awareness regarding radiation risks and safety measures such as protective shielding and dose minimization was found to be insufficient, and communication from healthcare professionals regarding these aspects was limited.

These findings highlight the urgent need for improved patient education strategies, structured awareness programs, and effective communication to enhance patient understanding and ensure safer use of medical imaging procedures.

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