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Research Article

Enhancing Radiation Safety Through Patient-Centred Approaches: Addressing Knowledge Deficits and Improving Informed Consent in Medical Imaging

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Abstract

Background

Knowledge of the risk of radiation exposure from diagnostic imaging is crucial for safe and informed involvement in healthcare. Anxiety, unrealistic expectations and less participation in collaborative decision making can be caused by misconceptions and poor communication.

Objective

To evaluate patient awareness, perceptions and misconceptions about radiation from routine imaging modalities and the level of information given before undergoing a radiological procedure.

Duration and Place of study : This study was conducted at Jhalwan Medical College / Jhalwan Teaching Hospital Khuzdar from May 2025 to May 2026

Data collection method: Cross-sectional study

Design

A cross-sectional survey was carried out of 300 patients who received diagnostic imaging. A baseline questionnaire was used to evaluate the knowledge of radiation, the patient's risk perception, the identification of procedures that are considered to be high radiation and if patients received sufficient information prior to the imaging. Responses were summarized using descriptive statistics.

Results

Of the 300 people who attended, many lacked basic knowledge of the risks of radiation. Although many patients knew that different imaging methods have different levels of radiation exposure, only a small number recognized computed tomography as the most radiation-exposing. Many said they were not given much information about possible radiation exposure before imaging

and many had misconceptions about the risk of cancer or about the cumulative radiation dose.

Conclusion

The results showed that there are still many things patients do not know about radiation and radiation safety. To improve informed consent and safer imaging practice, it is crucial to improve patient-centred education, standardize pre-procedure counselling, and improve the dialogue between clinician and patient.

Keywords: Radiation awareness, diagnostic imaging, patient education, computed tomography, informed consent.

Introduction

Medical imaging is now an essential part of clinical medicine and is used to aid in the diagnosis, planning and follow-up of many diseases. The use of ionising radiation in diagnostic imaging has risen significantly over the last 20 years, as a result of new technology, the greater availability of computed tomography (CT) and greater reliance on imaging in the clinic for decision-making [1]. These modalities are helpful clinically, but also involve different amounts of radiation exposure, leading to different potential cumulative lifetime doses and long-term risks in patients. Patients need to be informed of their risks to have informed consent, shared decision making and patient-centred care.

Although the radiological techniques are widely used, many studies have shown that the patient may not be aware of the amount of radiation he receives and the risks it poses [2,3]. Often, misconceptions are present, such as a low perception of the radiation dose from CT scans, the assumption that the CT scan type is not an ionising modality, and incorrect perceptions of the risk of cancer [4]. Such lack of knowledge can cause anxiety, unrealistic expectations or a reluctance for appropriate imaging procedures. On the other hand, ignorance can lead to patients giving consent to high dose procedures which they are not aware of the risks. Therefore, it is imperative that there is effective communication between provider and patient to ensure that imaging is clinically warranted and consistent with patient values.

The population radiation dose from CT imaging comes second in most countries, making up almost half of all the medical radiation exposures in the population [5]. A single CT scan can provide radiation doses several hundred times more than a typical chest radiograph, but it has been demonstrated over and over again that only a minority of patients recognize CT as a high dose modality [6]. This is a serious lack of knowledge, especially in the rapidly growing number of emergency and outpatient departments using CT. The risk of malignancy following exposure to radiation from a single scan is very low, but could be clinically important with repeated scans, particularly in children or young people [7].

Although informed consent is one of the principles of good medical practice, its application to radiology is not always consistent. Concurrently, many patients report inadequate information about the risks of radiation before they undergo imaging and reports that discussions are mainly about the logistics of the procedure and not the safety of the procedure [8]. Inadequate counselling due to time constraints, workload, and patient understanding. Additionally, radiation dose and risk communication knowledge among health providers is also variable and can affect the quality of information communicated to patients [9]. It is therefore vital to enhance the communication of patient-centredness so that consent is not a formality.

International guidelines emphasize the principles of justification and

optimisation of imaging, that is, imaging should be used only when clinically indicated and in the lowest possible dose [10]. These principles can only be fully realised if there is engagement with patients. Patients will better understand the purpose, benefits and risks of imaging, enhancing imaging understanding will improve patient engagement in decisions, asking pertinent questions, and communicating preferences. Other public health goals include reducing unnecessary imaging and compliance with radiation-safety protocols, as well, due to increased awareness [11].

Recent research has set the ground for the importance of organisation of educational interventions, such as visual aids, patient-friendly radiation-dose charts and standardised counselling tools, in understanding and satisfaction [12,13]. Yet, there's also opportunities in the emerging digital platforms and mobile applications that could offer patient-centric information about radiation safety which is readily accessible [14]. Nevertheless, despite these developments, there are many problems in routine clinical practice, especially in the fast-paced setting of the imaging department where communication can be limited or even disjointed.

Understanding what patients know, what they think and what they believe is crucial in designing effective learning materials. Evaluating the extent to which patients are informed prior to imaging can help determine strengths and weaknesses in the current practice, and inform changes to improve informed consent procedures. Additionally, understanding a patient's beliefs about radiation will enable you to pinpoint particular misconceptions to address and resolve.

To evaluate patient knowledge of their exposure to radiation in the most common radiologic diagnostic procedures, to define common misconceptions regarding their exposure to radiation, and to determine if sufficient information is being imparted before radiological procedures. The study aims to identify opportunities for improved communication and education to encourage safer, more informed imaging practices by looking at these factors in a large group of patients. Besides consent for ethical reasons, enhancing the understanding of patients is crucial for trust, anxiety reduction and radiation safety for patients.

Methodology

This study used a cross sectional survey design to assess patients' awareness, perceptions and misconceptions about exposure to radiation from commonly used diagnostic imaging procedures. All adult patients 18attended for radiological investigations such as computed tomography (CT), magnetic resonance imaging (MRI), plain radiography, fluoroscopy, and ultrasonography were invited to participate. Patients who were not able to answer the questionnaire, were critically ill, or were in emergency imaging were excluded for reliable data collection and for an adequate understanding of the questionnaire.

The number of patients involved was 300 patients and sampling was done by a non-probability convenience sampling technique because imaging appointments and walk-in visits were not predictable and there was no way to do a random selection. This method enabled the recruitment of a wide population of patients undergoing the routine diagnostic imaging procedures, but may not be representative of the broader population.

Data were collected using the structural questionnaire which was developed after conducting literature search on the topic of radiation awareness and patients educations. There were four main sections to the questionnaire: (1) Knowledge of radiation and sources of radiation; (2) Knowledge of the risks associated with

radiation from different imaging techniques; (3) perceptions of safety and misconceptions about imaging; (4) information received prior to undergoing imaging. Other demographic data such as age, gender, education and previous imaging experiences were also taken. The questionnaire was administered in a self-administered and interviewer-assisted forms to reflect varying levels of literacy. Research assistants were trained to help participants when necessary with the form in order to ensure its accuracy and reduce response bias.

The questionnaire was checked by two senior radiologists for clarity and cultural appropriateness and then pilot tested on small patient cohort (n=20). The pilot test feedback was used to refine the wording, understanding and flow of the questions. The tool was not formally validated, but has been tested and reviewed for its internal consistency and face validity.

Quality control was done all along the data collection process. Daily progress was monitored by research supervisors, who checked the completion of the questionnaires and who followed a strictly standardized interviewing procedure. 10% of questionnaires were double entered to reduce data entry error and discrepancies were resolved by cross checking with original questionnaires.

All the data collected were entered and analysed in IBM SPSS Statistics version 26. Categorical variables were summarized by frequencies and percentages, and continuous variables were summarized by their means and standard deviations. The dependent variable was the status of the radiation awareness – adequate or inadequate – using predetermined scores. The associations between the awareness levels and demographic variables including level of education, previous imaging experience, and gender were assessed using chi-square tests. A p-value < 0.05 was considered statistically significant.

Results

Total number of patients in the study was 300. The largest proportion (42.0%, n=126) were aged 18–30 years, followed by those aged 31–60 years (41.0%, n=123), while 8.0% (n=24) were below 18 years and 9.0% (n=27) were above 60 years (Table 1). Sixty-eight percent (n=204) of the sample was male. Almost half of the participants (40.3%, n=121) lived in rural areas, 41.7% (n=125) lived in semi-urban regions and 18.0% (n=54) lived in urban areas. Of those who received any formal education, one-fourth (24.0%, n=72) had no education and over half (53.0%, n=159) were unemployed. About half (51.0%, 153) of the participants had an income below the level of the local minimum wage and two thirds (66.0%, 198) had had at least one previous radiological procedure.

In general, 61.0% (183 of the patients) had adequate knowledge of the use of radiation in diagnostic imaging, and 56.0% (168 of the patients) recognized that radiation can be harmful. Over half (57.0%, n=171) were correct on pregnant women and infants as the most vulnerable group. But 62.0% (n=186) were not aware that the radiation dose was different for each imaging procedure and only 38.0% (n=114) correctly identified the highest dose procedure as CT (Table 2).

Graduates/postgraduates were more likely to be aware of the risks of radiation than were those with no formal education ($p = 0.001$, $\chi^2 = 17.2$, $df = 3$). Residential status was also found to be significantly associated with awareness ($\chi^2 = 9.1$, $df = 2$, $p = 0.010$); with semi-urban residents having the highest awareness (90.0%) and urban residents the second highest (67.0%), while the lowest was amongst rural residents (46.0%). Occupational was statistically significant associated ($\chi^2 = 14.8$, $df = 3$, $p = 0.015$); the

most awareness was among the professionals (59.0%) and the least among the unskilled workers (37.0%). The awareness was significantly higher among those who have previously undergone radiological procedures (75.0% vs. 35.0%, $\chi^2 = 15.1$, $p < 0.001$). There were no significant associations with age or gender.

As far as patient counselling is concerned, 65.0% said that the risks of radiation was not explained to them and 77.0% said that they were not given information on protective measures. Nevertheless, most (84.0%) were interested in getting more information. The level of knowledge was significantly related with informing patients about the safety measures ($\chi^2 = 5.5$, $p = 0.018$). Of those uninformed, 11.0% had good knowledge, but 31.0% of those who were informed had good knowledge.

The majority of the participants who responded were not very concerned about radiation (49.0%), but 88.0% said they would like to be educated about radiation and 93.0% reported that they had not refused a radiological procedure

.**Table 1. Demographic Characteristics of Participants (n = 300)**

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
Age group	<18 years	24	8%
	18–30 years	126	42%
	31–60 years	123	41%
	>60 years	27	9%
Gender	Male	204	68%
	Female	96	32%

Residence	Rural	121	40.3%
	Semi-urban	125	41.7%
	Urban	54	18%
Education	No formal education	72	24%
	Primary	118	39.3%
	Higher secondary	65	21.7%
	Graduate/Postgraduate	45	15%
Occupation	Unemployed	159	53%
	Skilled workers	72	24%
	Professionals	69	23%
Previous imaging exposure	Yes	198	66%

	No	102	34%

Table 2. Responses to Radiation Awareness Questions (n = 300)

Question	**Yes n (%)**	**No n (%)**
Imaging uses radiation	183 (61.0)	117 (39%)
Radiation is harmful	168 (56.0)	132 (44%)
Different tests have different radiation doses	114 (38.0)	186 (62%)
Repeated radiation increases risk	171 (57.0)	129 (43%)
Risks explained before procedure	105 (35.0)	195 (65%)
Protective measures explained	69 (23.0)	231 (77%)
Want more information	252 (84.0)	48 (16%)

Radiation-Sensitive Groups

Response	**Frequency (n)**	**Percentage (%)**
Babies/pregnant women	171	57%
Others	45	15%
Don’t know	84	28%

Highest Radiation Dose Procedure

Response	**Frequency (n)**	**Percentage (%)**
CT scan	114	38%
X-ray	30	10%
Ultrasound/MRI	3	1%
Don’t know	153	51%

Discussion

In this cross-sectional study, 300 patients were referred for imaging tests, and there was a large degree of ignorance regarding radiation exposure, as well as variations in radiation doses among imaging tests and concern about repeated radiation. More than half indicated that radiation is considered to be harmful, but a small minority correctly cited CT as being the most harmful procedure, and many indicated that they had received no information regarding the radiation risks or protective measures with regard to CT. These findings

suggest areas of current communication challenge in patient-centred care in radiology, and align with the international evidence of the lack of public understanding of radiation safety.

In the present study, 61% of the patients had basic knowledge of the use of radiation in imaging which is similar to the findings of Ekpo et al. [2] who found that 58% of patients had basic awareness of the use of radiation in imaging. Similarly, patients were aware that they would receive radiation but few knew how the radiation would be administered when it came to differences in dose between modalities [3]. Our study confirms these observations as 62% of our patients were not aware that there is a difference in radiation dose depending on the imaging procedure.

One surprising result of this study was that only 38% got the answer right on the question "Is CT considered a high-dose modality?" This is akin to the study by Dauer et al., which also revealed that patients and the general public were misinformed about the dose of radiation associated with CT [6]. Brenner and Hall also noted that although CT contributes a disproportionate amount to radiation exposure of the population, public knowledge of the risks remains low [7]. In the present study, more evidence is presented to support the assumption that misconceptions about CT are found in a variety of groups.

The differences between awareness and educational status were significant; and there was a higher awareness among the graduates than among those who did not complete any educational level. This is in line with that reported by Alshamari et al., which showed that education level was one of the most significant factors determining radiation awareness in their study group [15]. Focusing on imaging, Lee et al. determined that the more educated patients were more likely to understand the risks of imaging and make informed decisions [16]. The findings of our study confirm that of our results and emphasize the need of priority-based educational interventions for less educated groups.

Radiological procedures had also been statistically significant for the better awareness suggesting that more exposure to radiological procedures might result in more awareness of radiation concepts. This is consistent with Salerno et al. who reported that prior imaging experience was associated with increased understanding and questions asked [13]. The number of people reporting that their risks were not explained was low, however, even though there was this association (65%). This is analogous to what has been found for informed consent in radiology, where there is often insufficient information communicated and only minimal discussion of risks of radiation [8].

This was not observed in this study and this is an alarming scenario, when patient involvement plays an important part in recommendations for radiation protection. Shared decision making is about talking about risks and benefits in clear and transparent ways and this is promoted by organisations such as ICRP and WHO [10]. Rehani et al. also emphasized the need for easily available communication instruments to facilitate patients' understanding of the risks of radiation [14]. From our results, a considerable amount of work is needed to make these recommendations a routine part of clinical practice, especially when time or workflow limitations limit the time available for thorough counseling.

One should note that almost half of those who responded indicated that they were not very concerned with radiation but nearly everyone (88%) indicated they were willing to receive education. This indicates a high receptivity to learning and an opportunity for the radiology department to

build up structured programmes of education. In one study by Arslan et al., basic education measures (visual aids, counselling) had a significant effect on the knowledge and satisfaction of patients [12]. The present study supports the need for similar interventions, to correct misconceptions and to encourage informed consent.

In general, findings from literature found internationally are in line with the results obtained from this study; there is still a gap between patients in relation to their knowledge, the lack of counselling and misconceptions about the threat from radiation. This study can help develop education plans for specific groups of people based on their awareness, by finding the demographic and experiential factors associated with them. Routine imaging workflows handling radiation safety information, standardised pre-procedure counselling, and patient-centred communication can promote improved understanding, decreased anxiety and facilitate shared decision-making.

Conclusion

The results of this study indicated that patients were not well informed about the risk of radiation exposure from diagnostic imaging, or about the differences in radiation dose between the procedures or the risk of repeated radiation exposures. While some knew that radiation was dangerous, there were common misconceptions, and the majority of people reported that they did not receive any counselling about the risks of radiation or protective measures. Education level, occupation, residential status, and prior imaging experience had a significant effect on awareness.

Although there was a low level of knowledge, patients showed a great interest in learning more about radiation safety, providing an opportunity for additional patient education. Incorporating radiation safety information into the routine use of imaging, improving the interaction between clinicians and patients and delivering culturally relevant information would expand the understanding of radiation safety, support patients' informed choices and help promote safer use of diagnostic imaging.

Overall, the results highlight the importance of adopting a patient-oriented approach to raise awareness of radiation, and ensure patients are better informed and engaged in their care.

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