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Research Article

Awareness of Basics of Radiation, Dose Levels of Imaging Procedures and Radiation Safety among the Nurses in an Academic Hospital in Himachal Pradesh, India: Results of a Cross Sectional Study

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Abstract

Objective: To illustrate our institutional experience about the awareness of basics of radiation, dose levels of imaging procedures and radiation safety among the nurses in Himachal Pradesh.

Methods: Data was obtained from a multiple question based survey conducted in a group of nurses from the various departments between May 20, 2020 and June 01, 2020. The survey was designed to assess the knowledge and awareness of basic radiation types and effects, dose exposure levels and radiation protection among the participants. Questionnaires were distributed both physically where ever feasible and online using google form. Participation to the survey was voluntary and completely anonymous.

Results: Regarding the question of type of radiation that is harmful for living beings, 93.4% of the participants correctly responded that ionizing radiation is harmful, 3.6% said non ionizing radiation is harmful while 3% were not sure about it. Overall, 41.6% of the respondents were aware that of radiation is helpful in diagnosing diseases, treating cancer and can cause cancer. Only 30% of the respondents felt the need to confirm LMP or pregnancy status of a woman of child bearing age before subjecting her to an abdominal/pelvic CT or a nuclear medicine procedure, where as a small but significant 6.8% responded that the radiation dose received from these modalities is very low and of no concern where as 3.6% respondents reported that they were not sure of what should be done. Only 34.6% of the participants were able to tell that children are mostly affected with radiation. Overall 88.97% of the respondents found that it is very important to have knowledge of the radiation dose of common radiological investigations and procedures. Only 48.5% of the participants were aware of nuclear medicie department, others were not aware of it.Overall 66.9% of the participants thought that their knowledge needed improvement and that they would prefer a workshop to update themselves where as 22% participants though class room lectures would be appropriate to enhance their radiation dose levels and safety related awareness. Only 32 % of the participants were aware that radiation is used to diagnosing, treating and can cause cancer. Only 18 % of the participants were able to tell DEXA Scan, Kidney Scan tests, Thyroid Scan and Bone Scan come under Nuclear Medicine department. Only 10% of the participants were able to say that the modalities which uses ionising radiation are X-Rays, CT scan, PET Scan, Throid scan. The radiation exposure from background radiation was correctly estimated by 45.9%.

Conclusion: The results of our study show that the knowledge of nurses in our institute is significantly worse due to lack of their formal training. And there is need to create awareness among the nurses starting from their clinical training period. Future studies should investigate knowledge of radiation protection and performance of radiation protection behavior in nurses, such as those working in the general ward or specialized departments, and educational needs should also be studied to develop customized radiation protection education programs.

Keywords: Ionizing Radiation; Dose Exposure Levels; Education Programs

Introduction

In the modern medicine there has been increase in the use of ionising radiation-based diagnostic modalities such as digital X-rays, mammography, flouroscopy, multidetector computed tomography (CT), PET-CT scans (Positron Emission Tomography) and various other nuclear medicine scans. This has led to a greatly increased utilization of these investigations and hence resultant increase in overall radiation exposure. The biological effects of ionizing radiation are well recognized and the effects can be detrimental to well being of the patients if there is over exposure or repititive exposure to ionizing radiation without justification. Despite of many the recent wide advances in medicine, it can be hazardous if not properly handled. A careful balance between the benefits of enhancing human health and the risks related to the radiation exposure of radiographers, patients and the public, has to be involved in the practice of diagnostic and interventional radiation.

Nurses play very useful roles from the care, diagnosis of disease till treatment of patients. There is an anticipation that nurses should have enough knowledge and should be able to give informed explanations about diagnostic procedures that their patients may undergo. Therefore it is very essential to make sure that all the involved nurses, present and those in their training years, are aware of the risks of ionizing radiation, the radiation dose levels involved with respect to these investigations and hence follow the up-to-date justification and optimisation criteria for use of ionizing radiation.

Studies have documented that most people overestimate the risk of industrial radiation and underestimate the risk of medial radiation application [1]. Over the last decade, several studies have been conducted on nurses of various academic institutes world wide, and disappointing many of them have revealed an alarming lack of basic radiation and protection knowledge among the particiipants. In particular, a substantial percentage of nurses were found to be underestimating the overall radiation doses associated with various imaging modalities and in some cases, they were not even able to correctly differentiate between ionising and non-ionising radiation-based imaging techniques.

A nurse is a highly trained professional involved in the care for the sick and also educates patients regarding healthy living in current or chronic disease processes and treatment [12]:

i. Prepares the patient for imaging procedures
ii. Supports the patient through imaging procedures
iii. Care the patient post imaging procedures
iv. Assists in imaging procedures
v. Maintains a safe environment within the imaging department
vi. Undertakes specific interventions within the 'imaging environment [2].

As we read some of the reports; we realized that that it would be prudent to evaluate the knowledge and awareness of basic radiation protection issues needed for daily practice by the nurses in our hospital, in an attempt to gain insight about the current status of radiation protection education among them who will follow the instructions of medical imaging examinations and procedures in their professional life.

So with perspective, the advantages of creating a positive radiation safety awareness in the during the educational or training years have been outlined, with continuous education and testing for all the involved nurses (including those on training) being the key to optimise performance, minimise errors and protect the entire work force as well as the general public and the environment.

Aim of the Study

The aim of our work was to assess the degree of subjectively perceived awareness, and basic knowledge towards radiation, its effects, dose level assessment and radiation protection among the nurses in our institute.

Materials and Methods

Data collection

Data was obtained from a multiple question based survey conducted in a group of nurses from the various departments between May 20, 2020 and June 01, 2020. The survey was designed to assess the knowledge and awareness of basic radiation types and effects, dose exposure levels and radiation protection among the participants. Questionnaires were distributed both physically whereever feasible and online using google form since during the present COVID-19 scenario, direct contact with a large number of paticipants was not possible. Prior to the survey, participants had been informed that the results of the questionnaire would be stored in a database and used for research purposes only. Participation to the survey was voluntary and completely anonymous.

Institute research ethics committee approval was obtained for this study and implied consent was assumed if the survey was completed and submitted.

A total of 245 nurses including those in their training, were invited to enroll in the survey. This survey was divided into four sub sections as described under:

- **Section 1:** Contained the characterstic data of each survey participant, as well as including their degree of training.
- **Scetion 2:** Contained questions regrading knowledge about ionising radiation modalities and dose levels involved in some of the commonly used investigations.
- **Section 3:** Dealt with knowledge regarding biological effects of radiation and basics of radiaion saftey.
- **Section 4:** Included questions about their previous training with respect ot radiation and their prefered mode of education to update their knowledge.

Statistical analysis

The data generated was both categorical and continuous in character. Categorical variables were expressed as percentages, whereas continuous variables were expressed as mean and standard deviation respectively.

The total questionnaire score and the two subscales (Radiation Protection and Dose Assessment) were expressed as median and interquartile ranges (IQR).

The score differences related to the questionnaire among the two groups (nurses students and staff nurse) were evaluated using the Kruskal Wallis test. Post analysis was performed using pairwise Mann-Whitney tests with Bonferroni correction. Mean scores were calculated for each respondent for each of the objective questions for which there was a single right answer.

To determine the statistical significance of the difference between participant groups, means were compared using a one-way analysis of variance. Statistical significance was defined at a p-value of less than 0.05. Statistical analysis was carried out using professional statistical software (SPSS).

Results

A total of 245 participants completed the survey. Of the 245 participants, 229 (93.5%) were nursing students and 16 (6.5%) were staff nurses working in different departments.

Radiation awareness

As to the questions related to radiation awareness issues majority of the participants were aware about the ionising radiation and its hazardous effects.

Regarding the question about harmfullness of radiation to the living cells, 97.9% of the participants correctly responded, whereas 2% respondents were not sure about it.

Regarding the question of type of radiation that is harmful for living beings, 93.4% of the participants correctly responded that ionizing radiation is harmful, 3.6% said non ionizing radiation is harmful while 3% were not sure about it.

Overall, 41.6% of the respondents were aware that of radiation is helpful in diagnosing diseases, treating cancer and can cause cancer.

Only 30% of the respondents were aware about the need to confirm LMP or pregnancy status of a woman of child bearing age before subjecting her to an abdominal/pelvic CT or a nuclear medicine procedure, where as a small but significant 6.8 % responded that the radiation dose received from these modalities is very low and of no concern where as 3.6% respondents reported that they were not sure of what should be done.

Only 34.6% of the participants were able to tell that children are mostly affected with radiation.

88.97% of the respondents found that it is very important to have knowledge of the radiation dose of common radiological investigations and procedures.

Only 48.5% of the participants were aware of nuclear medicie department, others were not aware of it.

Overall 66.9% of the participants thought that their knowledge needed improvement and that they would prefer a workshop to update themselves where as 22% participants though class room lectures would be appropriate to enhance their radiation dose levels and safety related awareness.

Only 32% of the participants were aware that radiation is used to diagnosing, treating and can cause cancer.

Only 18% of the participants were able to tell DEXA Scan, Kidney Scan tests, Thyroid Scan and Bone Scan come under Nuclear Medicine department.

Only 10% of the participants were able to say that the modalities which uses ionising radiation are X-Rays, CT scan, PET Scan, Throid scan.

The radiation exposure from background radiation was correctly estimated by 45.9% of the respondents, with 37% respondents underestimated the background exposure.

Of the 245 participants 51% reported that they gave important consideration to patient's radiation exposure while choosing/precribing a diagnostic invetigation while the rest of respondents gave cost of investigation and availability an important factor in deciding their invetigavion modality.

35.8% of the participants answered that that they no formal awareness/training sessions relating to radiation exposure, dose levels, and radiation safety during their medical career so far, where as rest of the 64.2% said that they had experienced either of, or both classroom lectures and workshop exposure regarding radiation exposure, dose levels and safety during their training/clinical work.

Questions asked	Responded correctly	Could not respond correctly	Were not sure about it
Ionizing Radiation Harmful to the Living Beings	93.4%	3.6%	3%
Radiation Can Diagnose, treat and cause cancer	41.6%	50%	9.4%
Need to confirm LMP/Pregnancy before Abdominal CT/Nuclear Medicine Procedure	30%	65%	5%
Children Most Commonly affected From Radiation	34.6%	56.4%	10%
Felt the need of knowledge of radiation exposure	88.97%	-	-
Awareness of Existence of Nuclear Medicine Department	48.5%	50%	1.5%
Modalities Using Ionizing Radiation	10%	90%	-

Table

Discussion

In the modern medicine, there is an ever evolving and increasing number of imaging modalities and so are increasing clinical indications for several imaging procedures and hence imaging referrals from the clinicians. Some of the imaging modalities such as digital X-rays, mammography, CT scans are commonly availability even in smaller centres, provide access to morphological characterstics of the disease in question, whereas others such as PET-CT and nuclear Gamma scanners and therapeutic nuclear medicine procedures are coming up with a rapid pace at both privately run and state run centres and provide one-stop shop for morphological and functional imaging and treatment. The rapid increase and utilization of the imaging modalities has raised a concern on the related increase in radiation exposure to patients and the overall populaption. This requires an increased awareness among the nurses who spend longest period with patients, both in practice and those in early stages of their training and active initiatives on their part so as to optimizie the utilization of these esential modalities and reduce the exposure to radiation of the patients and population in general.

As far as we are aware, this is the first and only study in the state, that has been conducted with an aim to assess the levels of awareness and knowledge regarding basics of radiation, dose levels and radiation safety among nurses, in an academic institute in the state.

The results of the study showed that the levels of awareness and knowledege were not appropriate and upto the mark among the nurses. This seems to be result of a general under statement to radiation dose levels and protection issues during their classroom and clinical training. And Also, these knowledge deficits can be explained by the fact that nurses working in our state were deployed at the radiology departments without any kind of training in radiology nursing. Also, similar findings were obtained in the studies conducted in South Africa, Turkey and Malaysia [3-5]. However, in some countries, for example, Sweden and Poland, there is a formal Bachelor of Science Degree in diagnostic radiology for nurses [6,7]. Interestingly, in other countries like Saudi Arabia and Guatemala, formal radiography education and training used to be offered to nurses as a supplement with the absence of professional radiographers. However, after the need for qualified graduate radiographers had been identified, academic radiography education and training were introduced [8,9].

It is obvious from these studies, that a lack of awareness due to neglect of radiation protection education during the training of nurses can have dangerous consequences, potentially resulting in an increased number of inappropriate requisition for ionizing radiation based imaging tests, lead into unjustified and unnecessary higher radiation exposure not only to the patients but also to those-operating these equipments.

Taking the objective performance scores of post graduate residents and clinical specialists separately, we found that post graduate residents significantly out performed clninical specialists knowledge of radiation protection issues ($P < 0.01$). This was quite disappointing given the rather low difficulty level of the questionnaire, which was aimed to assess a basic knowledge about radiation protection even among students without specialty professional training in radiology, such as medical students.

In the future as good patient care providers, the nurses are expected and required to be able to provide knowledge about the imaging technique for a given clinical scenario and will be held ethically and legally responsible for the justification of imaging procedures and radiation exposure, should gain a reasonable knowledge of radiation dose levels delivered to their patients.

In the present survey, significant number of respondents, reported their training with respect to radiation safety as inadequate. This is presumably related to the reason that the tutors mentoring the in-training doctors, tend to overlook the radiation exposure and safety related issues.

Evidence exists in the literature that radiation protection awareness among nurses is quite variable and hovers at definitely substandard levels in a substantial fraction of cases, even at academic or tertiary care centers. Keeping in view the results of previous studies along with our study, we can conclude that it would be a prudent initiative to promote the awareness and knowledge regarding radiation exposure and safety among non-radiological professionals, those in their training years and also ones in practice by complementing their learning curricula with specific theoretical and practical sessions coordinated with help of radiation safety officers or medical physicists.

Limitations of the Study

There are some limitations involved in our study. Firstly, it was a single center study, which prevented us from comparing and finding out any differences among working nurses, nurses under training and technicians from different academic institutions. Another limitation was that since our survey was limited to a single institute, though our sample size was of a moderate size, it was not large enough to assess the awareness participants specialty wise, as had been done in some of the other studies. However, it can still be considered to be of reasonably adequate and significant size to derive a statistically meaning full results so described. A third limitation was that since the study was carried out during the COVID 19 pandemic, direct contact with all the participants at one time and place was not possible, some of the participants were distributed the questionnaire through online portal and a we are not sure their responses were neutral or influenced by information sought from others or internet but we assume that the participants have not sought help from the internet or elsewhere to fill in their responses and even if they have, we presume that it has helped them improve their awareness.

Conclusion

The results of our study show that the knowledge of nurses in our institute is significantly worse due to lack of their formal training. And there is need to create awareness among the nurses starting from their clinical training period. Even though there has been an increased sensitization of the nurses towards building a better awareness towards radiation protection, still initiatives are required to ensure that radiation protection effectively becomes an essential part of the clinical practice of the nurses. This would be a recommended approach to protect not only the patients but also to optimize resources utilization, both in smaller centers and academic institutes. Future studies should investigate knowledge of radiation protection and performance of radiation protection behavior in non-ORnurses, such as those working in the general ward or specialized departments, and educational needs should also be studied to develop customized radiation protection education programs.

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Conflicts of Interest

There are no involved conflicts of interest.

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