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Radiology Knowledge and Attitudes towards CT Radiation Dose and Exposure: A Survey Study

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Abstract
Computed tomography (CT) is a crucial imaging technique in diagnostic radiology, offering highly sensitive and specific information. However, the increased use of CT scans raises concerns about radiation quantity and associated risks, especially in paediatrics. The principle of radiation protection emphasizes keeping radiation doses as low as reasonably achievable (ALARA), necessitating justified CT use, particularly in paediatric cases. Knowledge about CT radiation is essential for optimizing radiation dose and minimizing risks. This study aims to assess the knowledge, expertise, and competency of Radiology technician regarding CT radiation dose and hazards in paediatrics. A self-administered multiple-choice questionnaire was used to evaluate the attitudes and opinions of Radiology technician involved in ionizing radiation imaging studies. Results showed that 65% ± 13.5% of respondents had a good understanding of the carcinogenic risks associated with CT scans, with 80% acknowledging elevated cancer risks. However, awareness of specific radiation risks in head, chest, and abdominal paediatric examinations was lower, with only 48.5%, 56.5%, and 65% of respondents aware, respectively. The study recommends regular and specific training courses to enhance Radiology technician ' fundamental knowledge of CT radiation and improve radiation safety practices.
Keywords: computed tomography, radiologist, ALARA principle, paediatric, CT radiation risk

Introduction

Computed tomography (CT) is an indispensable tool in radiology, enabling the detection and evaluation of various diseases and medical conditions crucial for diagnosis and treatment planning. Its speed, accuracy, versatility, and non-invasiveness have contributed to its widespread adoption in medical practice. However, CT scans deliver significantly higher radiation doses compared to other imaging modalities, posing a greater risk, particularly for paediatric patients due to their smaller body size. The increased use of CT in paediatrics has raised concerns about potential long-term risks, such as an elevated lifetime cancer risk, especially considering the susceptibility of developing tissues and organs in children. Pelc et al., 2014)

Currently, CT accounts for a substantial portion of medically induced radiation exposure, emphasizing the importance of understanding and mitigating its potential risks. Several studies have highlighted a slightly increased risk of leukaemia and brain cancer in patients exposed to CT at a young age. While the exact causation of cancer risk from low-dose radiation remains debated, paediatric patients are considered to face a higher risk compared to adults. (Portelli et al., 2016)

Radiographers and Radiology technician play a crucial role in ensuring the judicious use of CT scans, adhering to established risk-benefit analyses and optimising CT protocols based on individual patient characteristics and clinical needs. Continual education and training are essential for healthcare practitioners to stay updated with CT strategies, radiation dose management techniques, and image quality optimization while minimizing radiation exposure. (Mathews et al., 2013)

Despite efforts to educate healthcare professionals, studies indicate a need for improved awareness regarding radiation quantities and associated risks in paediatric CT scans. Continuing professional development (CPD) programs are essential for radiographers to maintain radiological safety standards and stay abreast of advancements in the field. (AL-Rammah, 2016)

This study aims to assess the current protocols and knowledge regarding CT radiation in paediatric patients among Radiology technician in hospitals. The findings will inform strategies to reduce unnecessary radiation exposure through alternative techniques and enhanced training programs. (American College of Radiology, 2007)

Materials and Methods

Survey Preparation and Administration

To assess the existing knowledge and expertise for the Radiology technician , and provide a comprehensive view about the wide spectrum of CT techniques of the paediatric population , a questionnaire has been designed to cover the primary aspects related to the provided CT services and evaluating the potential radiation risk qualitatively. The first draft was reviewed by experts to determine content validity and the appropriateness of the knowledge parameters. Based on this review, a second draft was prepared and used in a pilot survey to evaluate the reliability of the data and the nature of the responses. Although the reliability was acceptable, a number of the respondents reported difficulties in understanding the question with respect to the answer options. Based on these results, a third draft was prepared to simplify the questions and prevent any misunderstandings in the questionnaire design. The final survey was generated on Google Surveys. The majority of the questions in this study provided options from which participants had to choose a response and furnished candidates with an index containing pre-defined, conceivable responses; although, participants were able to give more detailed answers if they preferred.

The survey was structured and close-ended. Ethical approval for this study was obtained from the Ethics Committee. Completion of the anonymized questionnaire was considered to be consent for inclusion in the study. The survey link was distributed to a random selection of 600 Radiology technician A total of 127 responses was received, 26 of which were incomplete and omitted from the data set, leaving 101 surveys for the final analysis. The population contains a spectrum of Radiology technician holding various academic and professional degrees following the official classifications provided by the Commission for Health Specialties, which include bachelor of medicine degree (MBBS), postgraduate diploma, master′s degree and academic philosophy of doctorate (PhD) or medical professional graduate (MD) degrees.

Section A of the questionnaire inquired about the participant's background, particularly academic qualification, CT experience, training and education on the risks associated with paediatric CT radiation, and participation in the various workshops, seminars, conferences, and self-directed studies (books, journals, etc.) related to CT. This section also focused on their experience in accredited courses conducted by professional associations.

Section B was concerned with the respondent's knowledge regarding CT protocols. The main queries focused on the frequency of updating CT scan protocols, the confidence of the radiologist regarding the correct modulation of the CT parameters, and basic questions relating to CT scan procedures.

Section C was related to the participant's knowledge regarding CT doses in paediatric patients. It tested their knowledge regarding familiarity with the 'as low as reasonably achievable' (ALARA) principle, the relationship between cancer and CT dose, alternative medical imaging techniques, organisational policy for explaining the effects of CT radiation on the child, explaining these effects to the child's guardian(s), etc.

Data Management and Analysis

Data were analysed using Statistical Product and Service Solutions (SPSS) v20. The reliability of the data was determined by calculating Cronbach's alpha (0.871) and indicated that the data was suitable for further

analysis. A knowledge score was calculated for each question with correct and incorrect responses given a score of 1 and 0, respectively. The knowledge score of all participants was represented as a percentage for CT protocol, radiation dose, and radiation risk. Furthermore, descriptive statistics were performed to compare knowledge scores (in percentages) regarding CT protocol and radiation dose and risk based on education, experience and training. Analysis of variance (ANOVA) was used to compare CT protocol and radiation dose and risk knowledge on various parameters.

Results

Of the 600 Radiology technician included in the study, a total of 101 (16.8%) from different health sectors completed the questionnaire. Most of the participants came from the Ministry of Health (44.6%). The majority of participants had a PhD or MD (70.7%), with the remaining responses coming from holders of a Master's degree (13.8%), an MBBS (13.8%), or a postgraduate diploma (1.9%). Among the participants, 50% had greater than 10 years of experience in radiology and 60% regularly participated in periodically organized training and education concerning CT radiation risk in paediatrics.

Most participants (65%) were aware of CT radiation dose and the associated risks in paediatric CT examinations. The majority of respondents (65% ± 13.5%) comprehended the dangers of carcinogenicity to the patient that occur as a consequence of a CT scan and 80% believed that the dangers of carcinogenicity are elevated due to CT scans. However, some respondents underestimated the risk associated with CT radiation in paediatric investigations of the head (51.5%), the chest (43.5%), and the abdomen (35%).

Participants were asked about the procedures within their department and their knowledge about CT protocols. Most of the respondents (88%) were familiar with the ALARA principle and 60% of the participants were not familiar with the effect of updating and altering the CT protocol on image quality and radiation dose. A significant number of participants (86%) considered an alternative imaging modality other than CT for paediatric examinations. Over half of the participants (59.4%) indicated that their departments had a policy to inform patients' families about radiation benefit versus risk and the radiation dose in CT examinations. Many participants believed that the radiation dose for CT examinations of the head (68.3%), chest (67.3%), and abdomen (58.4%) in their department are considerably low. These score results indicate that most of the participants have a good estimation for the CT examination of the head and underestimated the radiation doses for the chest and abdomen CT examinations compared to the reported estimated values in the CT centers for head, the abdomen, and chest examinations, which were found to be in the range of 0.6 and 2.5 mSv, 6.7 and 11.2 mSv, and 4.3 and 11.6 mSv. The majority of the participants were able to recognize the potential risk based on their knowledge of the delivered dose.

The impact of the participants' academic qualification, experience, and training on their knowledge concerning CT protocols and radiation dose and risk was then analysed. The overall mean score of the correct answers for CT protocol information and CT radiation dose were 55.6% and 64%, respectively. The PhD/MD participants reported the highest percentage of the correct answers (57.6%) about CT protocol information. No significant difference was observed in the CT protocol knowledge score based on academic qualifications. Postgraduate diploma participants reported the highest percentage of correct answers (91.67%) regarding CT radiation dose and its impact in diagnostic radiology, followed by Master's (69%) and PhD/MD (64.3%) participants. No significant difference was observed for the CT radiation dose knowledge score based on academic qualifications.

Participants with more than 20 years of experience had the highest knowledge score for both CT protocol (61%) and radiation dose (72.7%) information. No significant difference was observed between any other experience groups.

Participants having monthly training reported the greatest number of accurate replies regarding CT protocol (60%) and radiation dose (70%) information. There were no significant differences among participants who received training at longer intervals.

Taken together, these analyses show that there was no correlation between knowledge scores and qualification, experience, or training.

Discussion

The widespread adoption of CT technology in paediatric medicine necessitates careful consideration and precautions. Various organizations such as the International Commission on Radiation Protection (ICRP), National Cancer Institute (NCI), United States Food and Drug Administration (FDA), and International Atomic Energy Agency (IAEA) have developed guidelines for CT radiation doses in paediatric examinations. These guidelines emphasize radiation safety principles like justification, optimization, and constraints, with justification being the most critical. Despite efforts to optimize CT radiation doses for paediatric patients, many centers still use adult protocols for imaging paediatric patients, highlighting the need for appropriate guidelines and knowledge to avoid potential risks during these examinations. (Alreshidi et al., 2020)

Our study shows that most participants had a good understanding of CT radiation dose and associated risks in paediatric examinations. However, there were instances of underestimation of risk, especially for specific examination protocols like head, chest, and abdomen CT scans. This underscores the importance of continuous education and training to ensure accurate risk assessment and dose optimization based on the ALARA principle. (Medical Exposure Regulations, 2012)

It is crucial for healthcare institutions to regulate CT clinical practices based on established guidelines to minimize paediatric patients' exposure to radiation. Additionally, considering alternative imaging modalities and having clear policies to inform patients' families about radiation risks versus benefits can further reduce risks associated with CT examinations. (Mahmoudi et al., 2019)

The impact of participants' academic qualifications, experience, and training on their knowledge was analyzed. While there were differences in knowledge scores based on experience and training frequency, there was no significant correlation between knowledge scores and qualifications or training. This highlights the need for ongoing, targeted training programs to enhance awareness and knowledge among Radiology technician regarding CT radiation dose and protocols. (Bellolio et al., 2018)

Despite the study's limitations, such as self-reporting and potential biases in participant selection, it provides valuable insights into Radiology technician ' knowledge and awareness of CT radiation risks in pediatric examinations. Continuous education and training are recommended to improve awareness and ensure optimal radiation safety practices in pediatric radiology. (Peng et al., 2017)

Conclusions

This study highlights that while Radiology technician generally possess a good grasp of the fundamental principles of radiation protection and have adequate knowledge about the overall risks of CT radiation dose in pediatric patients, there exists variability in their awareness and understanding concerning CT dose and risk related to specific examination protocols. Therefore, it is advisable to conduct regular, frequent, and targeted training courses aimed at enhancing basic CT radiation awareness and knowledge among physicians overall, with a specific focus on Radiology technician . This continuous education approach can contribute significantly to ensuring optimal radiation safety practices and better risk assessment in pediatric radiology.

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