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FREQUENCY OF KNOWLEDGE, ATTITUDE, AND PRACTICES OF WORKPLACE RADIATION SAFETY AMONGST ANAESTHESIOLOGY TRAINEES AT TERTIARY CARE HOSPITALS OF SINDH AND BALOCHISTAN

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ABSTRACT

Objective: To determine knowledge, attitudes and practices of post graduate anaesthetist trainees of tertiary hospitals in Sindh and Balochistan, Pakistan, towards work place radiation safety.
Study design: Cross-sectional study.
Setting: Department of Anaesthesia, Civil Hospital Karachi and other tertiary care government and private training hospitals from Sindh and Balochistan.
Period: Six months.
Methods: A cross-sectional survey of 140 postgraduate anaesthetists who were selected by non-probability convenience sampling. The data was gathered by a structured, self-administered questionnaire which contained nine knowledge, four attitude and eleven practice questions regarding workplace radiation safety. The concepts of knowledge, attitude and practice were classified by a 50% cut-off point. The Chi square or Fisher's exact test were used to determine relationship between the participant characteristics and knowledge, attitude and practice level of the respondents, and $p<0.05$ was considered significant.
Results: The mean age of the participants was 30.3 years ± 3.8 and 82 (58.6%) were male. 92 (65.7%), 116 (82.9%) and 85 (60.7%) participants had good knowledge, attitude and practice, respectively. Age ($p=0.034$), type of training institute ($p=0.006$), and year of FCPS training ($p=0.003$) were significant factors associated with knowledge. There was significant association between good knowledge and adequate attitude ($p=0.006$) and good practice ($p<0.001$) and between adequate attitude and good practice ($p=0.001$).
Conclusion: The majority of postgraduate anaesthetists had satisfactory knowledge and attitudes towards workplace radiation safety; but workplace radiation-safety practices are still not optimal.

KEYWORDS: Anesthesiology; Occupational Exposure; Radiation Protection; Radiation Safety; Workplace.

INTRODUCTION

The use of ionising radiation in modern healthcare has become a key part of work that involves image-guided procedures such as mobile fluoroscopy and C-arm systems. These technologies have enhanced the accuracy of diagnosis and the outcomes of the procedure but have also introduced an increase in occupational exposure of healthcare workers. [1]. Conventional fluoroscopy-guided airway management, monitoring and perioperative care procedures often involve anaesthesiology trainees in close proximity to the patient, and thus repeated radiation exposure. Although the exposures can be small, they can still be occupational sources of radiation-related health risks, and it is imperative to have the right knowledge, attitudes, and practices at work. [2].

The three basic principles of radiation protection are: keep exposure time to a minimum, use maximum distance from the radiation source and use proper shielding. To be effective, all healthcare workers need to be familiar with the risks associated with radiation, biological effects, personal protective equipment, and positioning during the

procedure. But evidence has suggested that health professionals can exhibit a disconnect between their theoretically acquired knowledge and actual implementation of radiation-safety measures. [3].

Among students in anaesthesia and operating room nursing, a study found that there was a lack of knowledge and practices about radiation protection; it was emphasized that educational interventions should be made in structured formats before entering into clinical exposure [4]. Similarly, among operating room personnel, differences in radiation-safety awareness and practice were found, highlighting the need for institutional training as well as institutional safety culture. In another study, awareness and actual protective behaviour were found to differ significantly among operating-room personnel, indicating that the knowledge does not always guarantee the safe behaviour [5].

Studies of the operating-room nurses revealed that poor formal training was correlated with low radiation-safety preparedness and better knowledge with better protective practices [6]. Surgical trainees have also showed inadequate radiation-safety education while they are being exposed to radiation frequently in image-guided surgeries, which is a reason to make radiation protection an integral part of postgraduate training programs [7]. Practical training methods such as hands on fluoroscopy safety education have led to the increase in knowledge and awareness about radiation protection among trainees [8]. Research from clinicians using fluoroscopy also highlighted the variability in the use of protective measures and the need to standardize radiation-safety education [9]. Furthermore, healthcare-worker studies have revealed that proper radiation protection is dependent on the awareness of the healthcare worker, protective equipment, monitoring systems and institutional policy [10].

This study was done because while anaesthesiology trainees are a population frequently around radiation sources during fluoroscopy-assisted procedures, they have not been sufficiently studied. The previous studies have been mostly confined to radiologists, surgeons, nurses and general healthcare workers and there was not sufficient data regarding anaesthetists trainees especially in tertiary-care hospitals of Sindh and Balochistan. International findings were not easy to transfer to the local context because of variations in training arrangements, work practices, provision of protective clothing and institutional safety arrangements. Hence, this study aimed to evaluate the prevalence of knowledge, attitudes and practices among anaesthesiology trainees in the workplace radiation safety risk reduction to highlight the areas of deficiencies for the development of targeted radiation-safety training programmes.

METHODS

A cross-sectional study was performed in tertiary care hospitals of Sindh and Balochistan among post graduate anaesthesia trainees. The study was conducted in the Department of Anesthesia, Civil Hospital Karachi, as a main data collection site and other Government and Private tertiary care training institutes approved by the College of Physicians and Surgeons Pakistan (CPSP). These comprised of Aga Khan University Hospital Karachi, Jinnah Postgraduate Medical Centre Karachi, Liaquat National Hospital Karachi, Dow University Hospital Karachi, Indus Hospital Karachi, Shaheed Mohtarma Benazir Bhutto Institute of Trauma Karachi, Kutiyana Memon Hospital Karachi, Liaquat University Hospital Hyderabad, Chandka Medical College Hospital Larkana, Peoples Medical College Hospital Nawabshah, Pakistan Naval Ship Shifa Hospital Karachi, Bolan Medical Complex Hospital Quetta, and Sindh Institute of Urology and Transplantation Karachi, National Institute of Cardiovascular Diseases Karachi, Ziauddin Hospital Karachi, Abbasi Shaheed Hospital Karachi. This study was carried out for six months after the research synopsis is approved.

The sample size was determined using the formula: $n = z^2p(1-P)/d^2$. Using an estimate from a pilot study of a 63.33% rate of good knowledge about workplace radiation safety, a 95% confidence level and 8% margin of error, the calculation was made. A calculated sample size of 140 participants was found. Recruitment of participants was done using a non-probability convenience sampling technique.

Postgraduate anaesthesia residents of both gender from 24-40 years of age who were working in government and private CPSP recognised training institute of Sindh and Balochistan were included. If the residents did not consent to participate, if they were MCPS trainees, and if they were consultant anaesthesiologists, they were excluded from the study.

Approval from the Institutional Review Board and CPSP was obtained and data collection was started. The administration of selected institutes was contacted and, a list of eligible anaesthesia trainees with their contact details was obtained. A self-administered questionnaire was designed and uploaded in Google Forms and the link was disseminated to the eligible respondents. Prior to participation, verbal informed consent was obtained. The questionnaire focused on the knowledge, attitudes, and practices on workplace radiation safety. There were nine questions in the knowledge domain, eleven questions in the practice domain, and four questions in the attitude domain. For every correct answer 1 point was awarded and 0 points for incorrect answers. Knowledge was

categorized as good (≥50%) and poor (<50%), attitude as adequate (≥50%) and inadequate (<50%), and practices as good (≥50%) and poor (<50%). A predesigned proforma was used to record the data of study variables.

The collected data was analyzed with Statistical Package for Social Sciences (SPSS) version 26. The quantitative variables (age, year of training, knowledge score, attitude score and practice score) were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR) based on data distribution. Normality was tested using Shapiro-Wilk test. Qualitative variables like gender, residence status, type of institute, year of FCPS training and categorized knowledge, attitude and practice levels were presented in frequencies and percentages. Stratification was done for potential confounding variables such as age, gender, type of institute and year of training. Fisher's exact test or Chi square test was done for post stratification analysis. A p-value ≤0.05 was considered statistically significant.

RESULTS

One hundred and forty post-graduate anaesthetists participated in the study. The ages of the subjects ranged from 24 to 40 years with a mean age of 30.3 ± 3.8 years. The majority of the respondents were 30 years old or younger (54.3%). There were 82 (58.6%) male and 58 (41.4%) female trainees. Most of the participants (75.0%) lived in urban areas and were receiving training in the government sector hospitals (59.3%). The average year of FCPS training was 2.55 ± 1.09 year. The highest number of training personnel was third year trainees (38 (27.1%)). Majority of the participants were under post graduate training in Sindh province with 21 (15.0%) participants under training in Balochistan province (**Table 1**).

The Shapiro–Wilk test showed that both knowledge and attitude scores were normally distributed while the practice scores were not normally distributed. The mean knowledge score was 5.8 ± 1.7 out of a maximum score of 9. The total number of good and poor knowledge of workplace radiation safety was 92 (65.7%) and 48 (34.3%) respectively. The mean attitude score was 2.9 ± 0.9 out of 4 points and 116 (82.9%) subjects had an adequate attitude. The median score was 6 (range was 5 to 8) for a maximum possible score of 11 on the practice score. Eighty-five (60.7%) showed good practice of radiation safety while 55 (39.3%) showed poor practice of radiation safety (**Table 2**).

In the stratified groups, good knowledge was significantly higher for participants aged >30 years than those aged 30 years and below (75.0% vs. 57.9%, p=0.034). The type of training institute (p=0.006) and year of FCPS training (p=0.003) were also significant factors related to good knowledge. The respondents of the private institutes and those who were at the later years of training showed higher values of "good knowledge". There was no significant difference between the knowledge level of both genders or of residents and non-residents (**Table 3**).

Adequate attitude was significantly related to the type of training institute with 91.2% of the trainees from private institutes had adequate attitude while 77.1% of the trainees from government institutes had adequate attitude (p=0.029). No significant differences were found between age, gender, residence status and year of training and attitude. There was a significant relationship between age (p=0.013), type of institute (p=0.003) and year of FCPS training (p=0.025) with good practice. The practice of good practices was more prevalent among the trainees older than 30 years, among trainees who were studying in private institutes and among the trainees who were in the later years of post training. There was no statistically significant relationship between gender and residence status and practice level (**Table 3**).

It was found that the participants having good knowledge were significantly more likely to have adequate attitude as compared to the participants having poor knowledge (89.1% versus 70.8%; p=0.006). Likewise, 73.9% of the participants who had good knowledge showed good practices, while 35.4% of the participants who had poor knowledge showed good practices (p<0.001). A significant relationship was found between knowledge, attitude and workplace radiation-safety practices, as good practice was also significantly more frequent among participants with an adequate attitude than among those with an inadequate attitude (67.2% versus 29.2%, p=0.001) (**Table 4**).

Table 1. Demographic and training characteristics of the study participants (n=140)

Characteristic	**n (%)**
Age (years)	
Mean ± standard deviation	30.3 ± 3.8
Range	24–40
≤30 years	76 (54.3)
>30 years	64 (45.7)
Gender	
Male	82 (58.6)
Female	58 (41.4)

Residence status	
Urban	105 (75.0)
Rural	35 (25.0)
Type of training institute	
Government	83 (59.3)
Private	57 (40.7)
Province of training	
Sindh	119 (85.0)
Balochistan	21 (15.0)
Year of FCPS training	
Mean ± standard deviation	2.55 ± 1.09
First year	31 (22.1)
Second year	36 (25.7)
Third year	38 (27.1)
Fourth year	35 (25.0)

Table 2. Knowledge, attitude, and practice scores regarding workplace radiation safety (n=140)

Domain	Maximum score	Descriptive score	Shapiro–Wilk p-value	Category	Frequency, n (%)
Knowledge	9	5.8 ± 1.7	0.082	Good	92 (65.7)
				Poor	48 (34.3)
Attitude	4	2.9 ± 0.9	0.064	Adequate	116 (82.9)
				Inadequate	24 (17.1)
Practice	11	6 (5–8)	0.018	Good	85 (60.7)
				Poor	55 (39.3)

Knowledge and attitude scores are presented as mean ± standard deviation. Practice score is presented as median and interquartile range. Good knowledge: score ≥5; adequate attitude: score ≥2; and good practice: score ≥6.

Table 3. Association of participants' characteristics with knowledge, attitude, and practice levels (n=140)

Characteristic	Total (n)	Good knowledge, n (%)	P-value	Adequate attitude, n (%)	P-value	Good practice, n (%)	P-value
Age group			0.034		0.074		0.013
≤30 years	76	44 (57.9)		59 (77.6)		39 (51.3)	
>30 years	64	48 (75.0)		57 (89.1)		46 (71.9)	
Gender			0.160		0.180		0.184
Male	82	50 (61.0)		65 (79.3)		46 (56.1)	
Female	58	42 (72.4)		51 (87.9)		39 (67.2)	
Type of institute			0.006		0.029		0.003
Government	83	47 (56.6)		64 (77.1)		42 (50.6)	
Private	57	45 (78.9)		52 (91.2)		43 (75.4)	
Residence status			0.217		0.605		0.089
Urban	105	72 (68.6)		88 (83.8)		68 (64.8)	
Rural	35	20 (57.1)		28 (80.0)		17 (48.6)	
Year of FCPS training			0.003		0.141		0.025
First year	31	13 (41.9)		22 (71.0)		13 (41.9)	
Second year	36	22 (61.1)		29 (80.6)		20 (55.6)	
Third year	38	28 (73.7)		33 (86.8)		25 (65.8)	
Fourth year	35	29 (82.9)		32 (91.4)		27 (77.1)	

Table 4. Relationship among knowledge, attitude, and practice levels regarding workplace radiation safety (n=140)

Explanatory variable	Category	Total n	Outcome present n (%)	Outcome absent n (%)	p-value
Knowledge level and attitude	Good knowledge	92	Adequate attitude: 82 (89.1)	Inadequate attitude: 10 (10.9)	0.006

	Poor knowledge	48	Adequate attitude: 34 (70.8)	Inadequate attitude: 14 (29.2)	
Knowledge level and practice	Good knowledge	92	Good practice: 68 (73.9)	Poor practice: 24 (26.1)	<0.001
	Poor knowledge	48	Good practice: 17 (35.4)	Poor practice: 31 (64.6)	
Attitude level and practice	Adequate attitude	116	Good practice: 78 (67.2)	Poor practice: 38 (32.8)	0.001
	Inadequate attitude	24	Good practice: 7 (29.2)	Poor practice: 17 (70.8)	

Chi-square test was applied. A p-value ≤0.05 was considered statistically significant.

DISCUSSION

In this study, the knowledge level regarding workplace radiation safety was found to be good in about two thirds of the postgraduate anaesthesia trainees whereas most of the trainees had adequate attitude towards radiation protection. But 60.7% reported good radiation-safety practices, showing that there is a gap between the knowledge and practice. The results indicate that while the trainees generally possess knowledge on radiation hazards, it is difficult to transfer that knowledge to routine clinical practice.

The extent of knowledge observed is similar to that found in other recent studies of healthcare professionals which suggest moderate to good levels of awareness of radiation hazards, but importantly there are still areas of deficiency. In the case of radiologists, physicians or other health care professionals, comparable investigations have shown knowledge about radiation dose limits, radiation biological effects and radiation protection principles is also inconsistent and structured educational interventions are necessary [11-14]. Similarly, in studies of medical students, there was satisfactory theoretical knowledge of radiation protection but serious misconceptions about radiation protection and imaging modalities, highlighting the need for comprehensive radiation-safety education in postgraduate curricula [15].

The attitudes toward radiation protection were generally positive with the majority of participants (>80%) having an adequate attitude. A similar situation has been reported among dental professionals, where there was also a great awareness of the importance of radiation protection, although knowledge and adherence to recommended practices varies [16]. The same positivity has been reported among Moroccan's dentists and nursing students indicating that occupational radiation hazards are widely recognized among healthcare professionals [17-19].

Although the knowledge and attitudes were relatively good, the radiation-safety practices of the participants were not good (60.7%). It is also noted that, even with good awareness, the use of PPE, dosimetre, and ALARA principles remained inadequate in previous studies [16,17]. The present study also showed significant correlation between better practice and age increment, training in private institutions and advanced years of FCPS training indicating that clinical experience and focus on radiation safety in institutions can positively influence better behavioural compliance.

There were significant relationships between knowledge and attitude, and between knowledge and practice, and between adequate attitude and good practice. These results corroborate the notion that knowledge can lead to positive attitude and in turn to work site behavior. However, there is a strong argument for the need not only to educate, but to also have institutional policies in place, regular audits, availability of protective equipment, and reinforcement of safety policies. Long term health effects from occupational continuous exposure to ionizing radiation, such as formation of cataracts, as well as other radiation related illnesses, are well known and underscore the importance of keeping to the radiation-protection standards [20].

Strengths and Limitations

The study offers up-to-date data on radiation-safety knowledge, attitudes and practices of postgraduate anaesthetists' trainees from two provinces in Pakistan employing standardized evaluation techniques. Because of its cross-sectional design, however, causal interpretation is not possible, and there may have been reporting bias for self reported practices. In addition, participants were drawn from selected training institutions, a sample which may not represent the general population.

Postgraduate anaesthetic training should include regular mandatory radiation-safety training, periodic refresher workshops, competency-based assessments and institutional monitoring of compliance. Future multicentre studies with a larger, geographically more diverse population should assess the effectiveness of the educational interventions in improving long-term radiation-safety practices.

CONCLUSION

Overall, postgraduate anaesthetic trainees had good knowledge and positive attitudes to radiation safety in the workplace, but the practice of recommended radiation safety was still not optimal. Better knowledge and practice was associated with older age, training by the private sector and higher years of FCPS training. Improved consistency of structured radiation-safety education, combined with institutional compliance with protective measures could enhance the adherence of future anaesthetists and decrease their occupational radiation exposure.

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