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Original Research

The Preventative Knowledge and Experience of Anesthesiology Students with C-arm Fluoroscopy

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ABSTRACT

Objective: Long-term C-arm fluoroscopy exposes medical personnel to substantial radiation doses. Preventing this exposure requires protective equipment and radiation safety. This study examined anesthesia students' using fluoroscopy and preventive knowledge.

Methods: This descriptive and cross-sectional study included 139 Vocational High School Anesthesia students. The "Healthcare Professional Knowledge of Radiation Protection" scale and a 13-question survey collected data. The scale was designed with a Likert scale and three sub-factors. If the total and sub-dimension item average score of the scale is below 5, it indicates that the level of knowledge of radiation protection among medical personnel is low, and if it is above 5, it indicates that the level of knowledge is high.

Results: More than half of the students (59.8%) heard the radiation from the fluoroscopy device, the vast majority (82.7%) did not receive radiation protection training, 58.3% stayed away from the device while it was operating, and 70.5% stated that it is crucial to stay away from the device while it was operating. It was determined that there was a statistically significant difference ($p<0.05$) in the "Radiation Physics, Biology, and Radiation Usage Principles" sub-dimension of students who were male, in their second year of education, received radiation protection training, and offered reliable answers to a number of questions measuring their level of radiation knowledge. In addition, the research revealed a positive and highly significant correlation between the scale and its subdimensions.

Conclusion: Although the scale scores of the students who received radiation protection training and had a high level of radiation knowledge were substantially higher than those of the other students, the average score of the students was less than 5. This indicates that students have an inadequate understanding of radiation protection. To prevent the negative biological effects of radiation on the human body, it is necessary to conduct epidemiological research, educate health care professionals and anesthesiology students about the effects and processes of this radiation on human cells, and provide frequent training. Radiation, radiation's biological effects, and radiation protection should be included in health students' curricula.

Keywords: Scopy, Radiation hazards, Radiation exposure

INTRODUCTION

Radiation, which is defined as the emission and transfer of energy from atoms, exposes humans to various forms and doses due to its expanding use in medical and industrial settings [1]. Radiation types are classified as either ionizing or non-ionizing [2]. Since the discovery of ionizing radiation in 1895, its usage in medicine has steadily increased. However, its ever-increasing use increases the population's exposure to radiation and poses a significant threat to public health [3, 4]. In addition, epidemiological research indicates that the ionizing radiation utilized in surgical operations and diagnostic imaging causes cancer [5]. Non-ionizing radiation is radiation that does not produce ions in the materials with which it interacts. This type of radiation includes microwaves, radio waves, ultraviolet light, and visible light as examples [6]. While modern diagnostic and treatment procedures facilitate the early detection and treatment of disease, they also increase radiation exposure and have irreversible biological impacts on patients, healthcare professionals, and students in the area of medicine [7]. Moreover, ionizing radiation might have negative impacts on cells. Ionizing radiation can cause chromosomes to splinter, clump, and twist. Chromosomes that have been broken may remain unchanged or unite with another chromosome. Resulting from these processes, mutation or cell death may ensue [8]. Fluoroscopy devices utilized in medical applications pose a danger of ionizing radiation exposure. C-arm fluoroscopy, which is extensively utilized in invasive surgery nowadays, is frequently employed in orthopedic surgery because it provides a clear image of the skeletal system [9]. Because of this, the use

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of long-term C-arm fluoroscopy systems exposes healthcare professionals and patients to excessive radiation doses [10]. To prevent this exposure, it is essential to employ protective gear and adhere to radiation safety regulations [11, 12]. Numerous strategies have been described to reduce the negative effects of radiation during medical procedures. Some of these were determined to be a lead apron, safety jacket, thyroid neck collar, and spectacles [7, 9]. It is crucial to take the risk of radiation seriously and to be knowledgeable about radiation [13]. There are three types of radiation exposure: medical, social, and occupational [14]. Radiation areas are defined as places where exposure to radiation is predicted to exceed 1 mSv for one year. Areas where the annual dose of radiation exposure is projected to surpass 1 mSv are referred to as "Radiation Fields." Examining the scientific literature, 1 mSv is a high equivalent dosage value and is typically stated as milliSv or microSv [3]. The maximum annual radiation rate indicated by the International Radiation Protection Association and the American National Radiation Measurement and Protection Association is between 20 and 50 mSv. These readings have decreased over time due to the radiation's long-term harmful effects [9]. In addition, according to the regulations of the Turkish Energy, Nuclear and Mining Research Institute (TENMAK, formerly the Turkish Atomic Energy Agency-TAEK), the effective dose for students aged 16 to 18 who are trained in the use of radiation sources should not exceed 6 mSv per year [3]. It is vital to determine whether the students take the required steps to prevent the anesthesia department students who will practice in this field as health care professionals in the future from the negative effects of radiation exposure. This topic, which is significant in terms of public health, requires research so that those who work or will work in the field of radiation can safeguard themselves and those around them. It is crucial that students who will become the future health care workforce do not put their health at danger during medical practices and are aware of the detrimental effects of radiation. This study aims to assess the fluoroscopy utilization and preventive knowledge of anesthesia department students.

METHODS

This study is descriptive and cross-sectional in design. The event took place during the spring semester of the academic year 2021-2022 at the Vocational School of a foundation university in Gaziantep.

The Sample Size of the Study

The study group was made up of 165 students at a Gaziantep foundation university who were in the Department of Anesthesia. The sample includes 139 students who volunteered to participate in the investigation.

Research Ethical and Legal Aspects

The Health Sciences Non-Interventional Ethics Committee at a foundation university accepted our study on February 28, 2022, with Decision No. 2022/016. The research was conducted in conformity with the Declaration of Helsinki, and participants were given verbal information and consent forms. Permission to use the scale was secured by email from the scale's owner.

Data Collection Tools

The data was collected between 1 March and 30 April 2022 using a 13-question questionnaire that included questions about the students' introduction, radiation, and fluoroscopy safety. In addition, the students were administered the "Healthcare Professional Knowledge of Radiation Protection (HPKRP)" in person during 45 min. Ay evaluated the validity and reliability of this scale in 2021 [15]. Schroderus-Salo et al. (2019) created the scale with 33 components and three sub-dimensions [16]. The universe and sample group for the development of the scale consisted of nursing professionals working in various clinics. The first, second, and third subdimensions of the Explanatory Factor Analysis (EFA) model of the scale had Cronbach's alpha coefficients of 0.96, 0.95, and 0.95, respectively. It was determined that the whole Cronbach's alpha coefficient of the scale was 0.93 and that the overall Cronbach's alpha coefficient was 0.97. The Cronbach's alpha coefficient was found to be 0.95 in our investigation. It is a 10-point Likert-type scale with 1 = I do not know and 10 = I have complete knowledge for each item. Calculation of scale score, scale It is calculated using the weighted average of the total and subdimension scores. A score between 1 and 10 is obtained from the scale. The scale's cutoff point was determined to be 5 If the total and sub-dimension item average score of the scale is less than 5 points, then the degree of knowledge of radiation protection among health workers is poor, and if it is greater than 5 points, then it is high. The scale has three subdimensions;

- Radiation physics, biology, and radiation usage principles (RPBP): It consists of 12 items (1-12) that assess the level of knowledge of healthcare professionals regarding the fundamental properties of radiation.
- Radiation protection sub-dimension (RPS): It consists of a total of 13 items (13-25) that assess the level of radiation protection knowledge among healthcare professionals.
- Guide to safe use of ionizing radiation (GSU): It consists of eight questions (26-33) that assess the level of knowledge of healthcare professionals regarding the radiation use guide.

Statistical Analysis

The application SPSS 23.0 was used to evaluate the data. Standard deviation, frequency, and percentage values were calculated during the data analysis. In descriptive statistics, the number (n) and percentage value (%) are used to describe categorical variables, whereas the mean standard deviation is used to express numerical values. Using the Kolmogrov-Smirnov test, the histogram, Q-Q plot, P-P plot, skewness and kurtosis values, the normality of quantitative data was determined. Independent Samples t-test and Single Factor Analysis of Variance were done on normally distributed independent groups. In groups that did not exhibit a normal distribution, the Mann Whitney U and Kruskal-Wallis H tests were conducted. The association between the "Healthcare Professional Knowledge of Radiation Protection (HPKRP)" and its sub-dimensions was determined using a simple correlation analysis. All outcomes of the study fell within the 95% confidence interval, and a p value of 0.05 was considered statistically significant.

RESULTS

It was found that 40.3% of the students in the study were between the ages of 19 and 20, and their average age was (21.101.90) (from 19 to 35). It was discovered that 78.4% of the students were female and 52.5% were in the first school year. More than half of the students (59.8%) heard the radiation connected to the fluoroscopy device, the majority (82.7%) did not receive radiation protection training, 58.3% stayed away from the device while the C-arm fluoroscopy device was operating, and 70.5% stayed away from the device while the C-arm fluoroscopy device was operating. Due to the fact that 61.2% of the students emit radiation, care should be taken when storing radiation protection equipment. Additionally, 51.8% of the students reported that there was a radiation hazard warning sign in the rooms where the C-arm fluoroscopy operates in the hospitals where they practice, and 62.6% of them pay attention to air exchange in the operating room where the C-arm fluoroscopy is used. stated that it should be the case. Table 1 reveals that 61.9% of the students stated that they ate a well-balanced diet to safeguard themselves from radiation harm, while 46.8% of them stated that they had never been in the room where the C-arm fluoroscopy was used in the previous year (Table 1).

When the scores of the Health Professionals' Radiation Protection Knowledge Scale and its sub-dimensions were compared with the gender, educational year, and radiation knowledge level of the students, it was found that male students, second-year students, and students with a higher level of radiation knowledge had significantly higher RPBP sub-dimension scores. In addition, it was determined that individuals who received radiation protection training had substantially higher scores in all subgroups and on the total scale. Table 1 provides a comprehensive breakdown of the questions indicating radiation knowledge levels and the significance values of the scale scores (Table 1).

The cumulative mean score on the HPKRP Scale was determined to be 3.95±1.68. When examining the sub-dimensions of the scale, "Radiation Physics, Biology, and Radiation Usage Principles" sub-dimension mean score was3.02±1.50, "Radiation Protection" sub-dimension mean score was 4.65±2.03, and "Safe Ionizing Radiation Use Guide" sub-dimension mean score was 4.20±2.12 (Table 2).

In our study, we also evaluated the relationship between the HPKRP and its subscales. A moderately positive correlation was

Table 1. Comparison of the Socio-demographic Characteristics of the Students and the Mean Scores of the Health Professionals' Radiation Protection Knowledge Scale and its Sub-Dimensions

	%	n	RPBP	RPS	GSU	Total Score of Scale
			Mean±SD	**Mean±SD**	**Mean±SD**	**Mean±SD**
Gender						
Female	78.4	109	2.85 ± 1.38	4.58 ± 2.01	4.08 ± 2.04	3.83 ± 1.63
Male	21.6	30	3.64 ± 1.79	4.91 ± 2.10	4.63 ± 2.37	4.38 ± 1.83
Statistical significance			t=2.621, **p=0.010***	t=0,777, p=0.439	t=1.255, p=0.212	t=1.594, p=0.113
Education Status						
First Year	52.5	73	2.76 ± 1.40	4.38 ± 2.14	3.91 ± 2.09	3.68 ± 1.71
Second Year	47.5	66	3.30 ± 1.57	4.95 ± 1.87	4.53 ± 2.12	4.25 ± 1.61
Statistical significance			t=2.166, **p=0.032***	t=1.660, p=0.099	t=1.739, p=0.084	t=2.026, **p=0.045***
Hearing the radiation associated with the fluoroscopy instrument						
Yes	59.8	79	3.29 ± 1.53	4.89 ± 1.87	4.39 ± 2.03	4.19 ± 1.59
No	43.2	60	2.66 ± 1.40	4.34 ± 2.20	3.95 ± 2.22	3.64 ± 1.76
Statistical significance			t=2.458 **p=0.015***	t=1.592 p=0.114	t=1.228 p=0.221	t=1.928 p=0.056
Status of receiving education about radiation protection						
Yes*	17.3	24	3.67 ± 1.60	5.58 ± 2.15	5.38 ± 2.80	4.84 ± 1.86
No	82.7	113	2.88 ± 1.45	4.46 ± 1.96	3.95 ± 2.01	3.76 ± 1.59
Statistical significance			t=2.389 **p=0.018***	t=2.518 **p=0.013***	t=3.093 **p=0.002***	t=2.928 **p=0.004***
Situation of staying away from the C-arm fluoroscopy device while it is operating						
Yes	58.3	81	3.30 ± 1.54	5.01 ± 1.90	4.46 ± 2.10	4.26 ± 1.60
No	41.7	58	2.62 ± 1.37	4.16 ± 2.12	3.84 ± 2.11	3.52 ± 1.71

Statistical significance			t=2.720 **p=0.007***	t=2.484 **p=0.014***	t=1.708 p=0.090	t=2.590 **p=0.011***
The necessity of maintaining a safe distance from the C-arm fluoroscopy while it is in operation.						
Yes	70.5	98	3.25 ± 1.56	5.00 ± 1.93	4.53 ± 2.12	4.25 ± 1.64
No	29.5	41	2.46 ± 1.22	3.81 ± 2.04	3.42 ± 1.93	3.23 ± 1.58
Statistical significance			t=2.881 **p=0.005***	t=3.258 **p=0.001***	t=2.894 **p=0.004***	t=3.389 **p=0.001***
Presence of a radiation hazard warning sign in the rooms where the C-arm fluoroscopy works in the hospitals where you practice.						
Yes	51.8	72	3.61 ± 1.64	5.38 ± 1.92	4.88 ± 2.18	4.61 ± 1.67
No	48.2	67	2.39 ± 1.02	3.87 ± 1.86	3.48 ± 1.80	3.24 ± 1.39
Statistical significance			Z=4.529 **p=0.000****	t=4.676 **p=0.000***	Z=3.572 **p=0.000****	Z=4.578 **p=0.000****
The necessity of paying close attention to air exchange in the operating room chambers in which the C-arm fluoroscopy operates.						
Yes	62.6	87	3.24 ± 1.58	4.86 ± 1.20	4.38 ± 2.20	4.16 ± 1.70
No	37.4	52	2.64 ± 1.29	4.30 ± 2.05	3.90 ± 1.96	118.85±53.49
Statistical significance			t=2.296 **p=0.023***	t=1.577 p=0.117	t=1.312 p=0.192	t=1.895 p=0.060
The state of paying attention to adequate and balanced nutrition in order to be protected from the harms of radiation.						
Yes	61.9	86	3.24 ± 1.62	4.87 ± 2.10	4.47 ± 2.28	4.18 ± 1.80
No	38.1	53	2.65 ± 1.23	4.30 ± 1.88	3.77 ± 1.75	3.57 ± 1.41
Statistical significance			Z=2.057 **p=0.040****	t=1.635, p=0.104	Z=1.527 p=0.127	Z=1.871 p=0.061
Frequency of C-arm scopy room visits over the past year.						
More than once a week	14.3	20	3.85±2.01	5.20±2.09	4.45±2.14	4.53±1.88
Once a week	18.0	25	2.83±1.26	3.94±1.42	3.79±1.85	3.50±1.42
Rarely	20.9	29	3.35±1.52	5.96±1.59	5.50±2.10	4.90±1.49
None	46.8	65	2.68±1.29	4.17±2.10	3.70±2.00	3.52±1.62
Statistical significance			F= 3.990 **p= 0.009*****	KW=16.373 **p= 0.001 *******	F= 5.836, **p= 0.001*****	F= 6.620, **p= 0.000*****

* Independent Samples t- test, ** Mann Whitney U test, *** One Way Anova test, **** Kruskal Wallis H test,SD;Standart Deviation

Table 2. Total Score Averages of the HPKRP and its Sub-Dimensions of Healthcare Professionals

Scale and Sub-Dimensions	Number of items	Min-Max	Mean±SD
Radiation Physics, Biology and Radiation Usage Principles	12 (1-12)	12-112	3.02±1.50
Radiation Protection	13 (13-25)	13-121	4.65±2.03
Guide to Safe Ionizing Radiation Use	8 (25-33)	8-74	4.20±2.12
Healthcare Professional Knowledge of Radiation Protection Scale (Total)	33 (1-33)	33-267	3.95±1.68

SD; Standart Deviation

found between the sub-dimensions of "Radiation Physics, Biology, and Radiation Usage Principles" and "Radiation Protection" and "Safe Ionizing Radiation User Guide" (respectively; r=0.691, p<0.01; r=0.676 p<0.01).

The relationship between "Radiation Protection" and "Safe Ionizer Radiation User Guide" is positive and highly significant (r=0.841, p<0.01). Positive and highly significant relationships were discovered between the sub-dimensions of the HPKRP Scale and "Radiation Physics, Biology, and Radiation Use Principles", "Radiation Protection", and "Guidelines for Safe Ionizing Radiation Use" (respectively; r=0.840, p<0.01, r=0.950, p0.01, r=0.914, p<0.01).

DISCUSSION

During fluoroscopic operations, professionals and students in this area may be exposed to ionizing radiation. It is advised that protective equipment be worn throughout radiation-causing processes, that the duration of the procedures be kept to a minimum, and that only required radiation-causing applications be performed [5]. In addition, according to the Radiology Services Regulation drafted by the Ministry of Health, the effective dosage for people who operate with ionizing radiation sources should not exceed 100 mSv for five consecutive years, 20 mSv yearly, and 2 mSv monthly [11]. Fluoroscopy-assisted medical operations are one of the most important parts of the success of modern medical practices. Nonetheless, the frequency of radiation exposure during fluoroscopy operations poses a concern to the public health of healthcare workers and anesthesia department students studying in this department. As a result, the amount of radiation protection knowledge the anesthesia students who will work in radiation sectors in the future possess and the education they get in this subject are strongly tied to their health. In our study, the majority of students heard the radiation emanating from the fluoroscopy, however 82.7% of students did not get radiation protection training. In research involving intensive care nurses, it was concluded that 37.3% had intermediate understanding and 62.7% had limited awareness about radiation safety [17]. Examining the literature, there are research indicating that employees in occupational categories including physicians and radiology technicians have inadequate awareness of radiation safety [18, 19]. It is evident that the findings of our study are comparable to those of previous research. In addition, our research revealed a strong correlation between students' understanding of radiation safety and their radiation protection practices. In this regard, we believe it is essential for students to establish appropriate radiation safety behavior and get instruction on this topic. The average overall score on the HPKRP scale for the students in our research was 3.95 ± 1.68 (Table 2). It was established that the "Radiation Physics, Biology, and Radiation Usage Principles" subdimension average score of 3.02±1.50 was the lowest among the other subdimension averages. Rahimi et al. revealed that the sub-dimension "Radiation Physics and Biology and the Principles of Radiation Use" had the lowest documented degree of knowledge, with a mean score of 4.69±2.49 [20]. When our study is analyzed in conjunction with other current studies, it is evident that the knowledge of the individuals who will work in the field of radiation about the notion of radiation safety as low as may be realistically achieved is crucial. In our study and in the literature, it was shown that students who practice in the health sector and health professionals who operate in this field are not well-informed about the unknown consequences of a given radiation dose on medical radiation [21, 22].

In our study, the socio-demographic features of the students and the mean scores on the HPKRP scale and its subdimensions were compared. Consequently, Those who study in the second year of education, learn about radiation protection, stay away from the device when the C-arm scanner is working, and say that it is important to stay away from the device when the C-arm fluoroscopy is working, and those who say that there are radiation hazard warning signs in the rooms where the C-arm fluoroscopy works in the hospitals where they work, their average score on the scale was statistically higher than others. Also, there was a statistically significant difference between the average results of the sub-dimensions of the scale and some sociodemographic characteristics of the students. Despite the significant differences indicated above, it was decided that the students' radiation safety knowledge level was inadequate, as the students' average score was less than 5. According to the findings of this study, radiation protection training is highly beneficial. Although they have understanding of the topic, they are not adequately aware of the radiation hazards in the units in which they practice. In addition, it was deemed beneficial that no other study in the literature investigated the usage of fluoroscopy and radiation protection knowledge among anesthesia department students using the HPKRP.

When the relationship between the HPKRP and its sub-dimensions was examined in the students who participated in our study, it was determined that there was a moderate, high, very high, and significant positive relationship between all of the scale's sub-dimensions. Based on these data, it was determined that the scale in our investigation was very accurate.

CONCLUSION

It was established that the understanding of the research participants regarding the usage of a fluoroscopy device and the radiation it generates was inadequate. Therefore, these students' ignorance of ionizing radiation may prevent them from protecting themselves and their patients efficiently. One of the primary responsibilities of public health is to reduce the impact of risk factors and boost protective ones. The use of ionizing radiation in medicine is one of the primary goals of public health; it is the most important factor in maintaining health, reducing the morbidity and mortality of individual diseases, and extending life, but irresponsible use and a lack of knowledge about the effects and mechanisms of radiation on human cells can result in serious health issues. To avoid the negative biological effects of radiation on the human body, it is necessary to conduct epidemiological research, teach health care professionals and anesthetic department students about the effects and processes of this radiation on human cells, and provide frequent training. Radiation, radiation's biological impacts, and radiation protection should be included in the curriculum of health students. On the basis of the data presented here, it suggests that these students require advanced educational preparation for safety precautions connected to ionizing radiation. To develop a culture of radiation protection, to adhere to national and international standards, to ensure their awareness, and to include them in their education courses on radiation and the biological effects of radiation, it is necessary to increase their education among anesthesia department students.

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