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Original article

Radiation Protection Knowledge, Attitudes, and Practices Among Fluoroscopy-Utilizing Doctors at Misurata Medical Centre, Libya.

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ABSTRACT

The aim of this study is to study the level of knowledge, attitude and practice among medical staff in Misurata medical centre using C-arm unit in operating theatre. A cross-sectional study of doctors in Misurata medical centre were carried out using a questionnaire distributed to doctors in various specialties using C-arm unit in the operation theatre. The questionnaire composed of 20 questions containing questions about general data (age, gender, marital state, specialty and years of experience), 5 questions about basic radiation protection knowledge, 3 questions about attitude and 6 questions about practice. 177 questionnaires were sent and 126 were recollected, the results filled out in Microsoft Excel and analysed using SPSS. A significant knowledge gap was identified among participants (n=112), with the majority lacking knowledge of radiation protection principles. Attitudes towards radiation protection measures varied, with a significant proportion of respondents recognizing the harm of using C-arm radiation without protection. Practice patterns showed significant proportion of unsafe practice. The study reveals significant knowledge gaps, suboptimal attitudes, and unsafe practice among non-radiology physicians using the fluoroscopy unit. Targeted educational intervention, increased availability of radiation protection equipment, and standardized protocols will improve these results and minimizing the risks associated with radiation exposure to both healthcare providers and patients.

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INTRODUCTION

Fluoroscopy units are used in various fields, including orthopedic, vascular, cardiac surgeries, pain management, and emergency procedures, and its use in the operating room has been increased in the last years especially after the improvement in technology and image quality making the fluoroscopy unit more accessible and useful in various surgical settings (1–3)]. However, medical professionals other than radiologists may lack the knowledge of radiation safety precautions, dosage optimization and long-term risk of radiation exposure, and using fluoroscopy unit in absence of proper knowledge and practice can lead to potential risks from ionizing radiation exposure to both patients and healthcare providers (4)(5)]. Fluoroscopy is a valuable diagnostic imaging technique that provides real-time visualization of internal structures using X-rays, it consists of an X-ray tube and an image intensifier (or flat-panel detector) arranged in a C-shaped configuration. The X-ray tube emits a continuous beam of X-rays, which passes through

the patient's body and detected by the image intensifier then displayed on a screen monitor (figure 1). Although the x ray beams travels in a straight line they scattered when passing through the patient's body and create a spherical field rather than a cone of radiation with its apex at the source of origin though the field of radiation is most intense near the x-ray tube (figure 2)(6)(7).

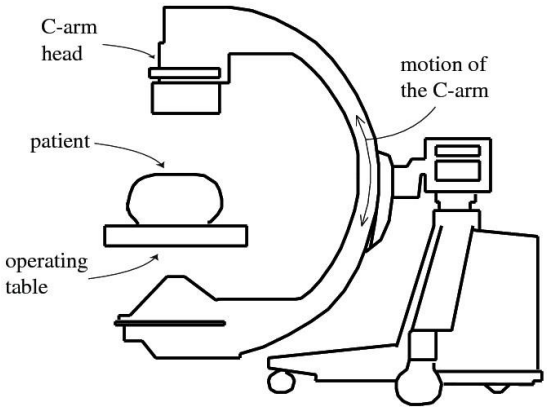


Figure 1: C arm fluoroscopy machine

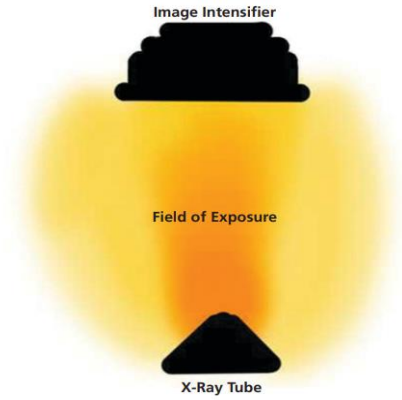


Figure 2: radiation Field around the fluoroscopy

There are two different kinds of fluoroscopy systems: the under-couch and over-couch models. In the over couch model, the X-ray tube is above the patient, while the detector is located beneath the patient, this system offers advantages in terms of reducing radiation exposure to the patient's body However, they expose the user to higher potential level of radiation. while in the under-couch model the X-ray source positioned beneath the patient, with the detector above the patient, these systems provide better protection from scattered radiation to the user [8].

Regarding the radiation exposure and its biological effects the terms effective dose and equivalent dose are the most common used values, the equivalent dose account for the type of radiation used and the ability of the ionizing radiation to produce biologic damage and its measures in sievert, while the effective dose takes into account all irradiated organs in the body and their relative radiosensitivity [9], For comparison and to understand the effective dose of various radiological examinations compared with chest X-ray, the effective dose of chest X-ray is 0.02 mSv, while the effective dose of abdominal CT examination is 12 mSv, which is about the same as 600 -fold corresponds [10], The annual dose limit for occupational exposure to radiation is 20 mSv, as recommended by the International Commission on Radiological Protection (ICRP) [11] shows the annual limits for occupational radiation exposure, based on the United States National Council on Radiation Protection and Measurements (NCRP), and the International Commission on Radiological Protection (ICRP) There are two types of radiation effects on the human body; the acute effect and the late onset effect. Acute effect, known as deterministic effect, in which symptoms occur at exposure above the tissue threshold, examples of this effect include alopecia, skin erythema, hematopoietic damage, gastrointestinal damage, central nervous system damage. As for the late-on-set effect, which is the stochastic effect that occurs without a threshold and includes teratogenic and carcinogenic effects, the risk for this effect increases with increasing dose, although it occurs without a threshold [12].

According to the ICRP recommendations, radiation protection is based on three principles: justification, optimization and dose limitation principles, in order to prevent the deterministic effects, limit the stochastic effects and minimize radiation exposure. Justification means that any measure associated with the use of the radiation procedure should be justified by a benefit that outweighs the risk, while optimization means that radiation exposure should be as low as reasonably achievable (ALARA principle). The dose limitation principle requires that the dose to individuals must not exceed national and international limits [13].

The aim of this study is to evaluate the knowledge, attitude and practice of non-radiology doctors using the fluoroscopy unit at Misurata Medical Centre (MMC) in Libya by collecting information using the questionnaire. There is currently a lack of information regarding the level of understanding and compliance with radiation safety measures among doctors in this specific setting. Identifying the knowledge gaps, attitudes, and current practices will assist in developing targeted interventions to improve radiation safety practices and minimize risks to both patients and healthcare providers.

METHODS

This study conducted at Misurata Medical Center (MMC) which is the largest hospital in the middle region of Libya the hospital has about 2000 worker from which 1000 is healthcare providers, this study was carried out from June to August

2023. A cross-sectional study of doctors in MMC were carried out using a questionnaire. We targeted doctors exposed to fluoroscopy radiation in operating rooms and they include following specialties (anaesthesia, orthopaedic, urology, vascular surgery and neurosurgery), according to data provided to us from the hospital they were around 177 doctors, we included all of them in the study except for who were sick or took annual, study and maternity leave and also didn't have the willingness to participate in the study during data collection.

A structured questionnaire was used to assess the knowledge, attitude, and practice of non-radiological doctors at Misurata Medical Centre who are exposed to radiation from fluoroscopy in the operating theatre. The questionnaire was comprised of three main sections: demographic questions, questions about radiation knowledge, questions on attitude, and questions on practice. The demographic section included questions on gender, age, marital status, specialty, and years of experience. These details provided a comprehensive overview of the participants' background and context. The section on radiation knowledge included 5 questions related to the participants' understanding of radiation safety. The section on attitude included 3 questions exploring participants' perceptions and beliefs regarding radiation safety. The practice section included 6 question and designed to assess the participants' actual practices and behaviours concerning radiation safety. 177 questionnaires were sent and 126 were recollected, the results filled out in Microsoft Excel and analysed using SPSS.

The questionnaire had a cutoff of approximately 50%; where doctors who scored 50% correct answers were considered to have adequate knowledge, while doctors who scored less than 50% were considered to have inadequate knowledge. Similar attitudes and practices were assessed according to the "Attitudes and Practices" sections. Three dichotomous variables were used as outcome variables, namely knowledge (appropriate/inappropriate), attitude (positive/negative) and practices (safe/unsafe)(14).

Ethical clearance and letter of approval were obtained from Misurata medical centre. The aim of the study was explained to the participants and a verbal consent obtained from all participants indicating their willingness to participate in the study. Thus, confidentiality was ensured by avoiding personal identification and restricting data access to third parties.

RESULTS

Of the 177-sample size 126 included in this study with a response rate of 89%, 86 (76.8%) were male and 26 (23.2%) were female, 65 (58%) were married based on year of employment 35.7% have less than 5 years and 40.2% have between 5 and 10 years of professional experience and 23.2% have more than 10 years. Participants included 30 anesthesiologists, 49 orthopedists, 14 urologists, 8 vascular surgeons, 11 neurosurgeons (table 1).

Table 1. Demographic and Professional Characteristics of Study Participants

Variables		Frequency	Percent
Age (years)	25-30	30	26.6%
	31-40	73	64.6%
	41-50	9	7.9%
	>50	1	0.9%
Marital state	Married	67	59.3%
	Not married	46	40.7%
Specialty	Anaesthesia	30	26.6%
	Orthopaedic	50	44.2%
	Urology	14	12.4%
	Vascular	8	7.1%
	Neurology	11	9.7%
Years of experience	< 5	40	35.4%
	5-10	47	41.6%
	> 10	26	23%

Regarding radiation protection knowledge, 70.5% do not know the type of C-arm used, 26.8% do not know the radiation-sensitive tissues, 94.6% do not know the annual dose limit for occupational radiation exposure, 75.9% do not know the amount of radiation to which they were exposed during each procedure, 59% do not know the stochastic and deterministic effects of radiation, 47.3% do not know the three principles of radiation protection (table 2).

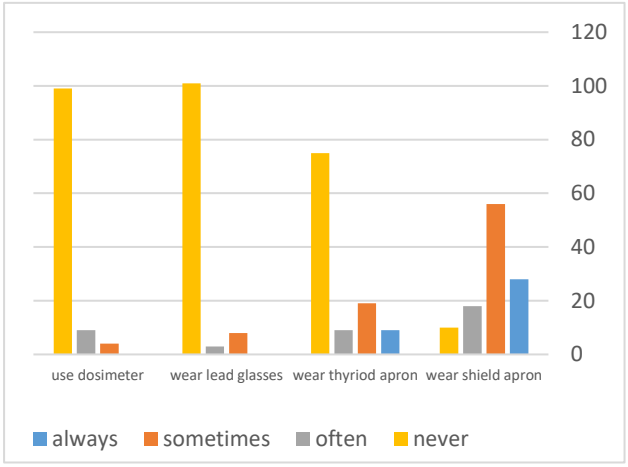
Table 2. Knowledge, attitude and practice about radiation hazards among doctors in MMC, with the most frequently answered choice (N=112).

Knowledge assessment	**Frequencies**	**Percentage**
What type of C arm unit do you use?		
don't know	79	70.5
Which tissue is more sensitive to radiation?		
Gonads	83	74.1
What is the annual dose limit for occupational exposure for radiation?		
don't know	95	84.8
Do you know the amount of radiation you exposed to in each procedure?		
Never	85	75.9
Do you know the amount of radiation you exposed to in each procedure?		
Never	85	75.9
Do you know the stochastic and deterministic effects of radiation?		
No	66	58.9
Do you know about the three principles of radiation protection?		
Yes	59	52.7
Attitude assessment	**Frequencies**	**Percentage**
Did you attend a lecture about radiation hazards before?		
No	79	70.5
Would you attend a lecture of radiation hazard in future?		
Yes	64	57.1
Do you think using C-arm radiation without protection measures is harmful		
Yes	94	83.9
Why you think medical staff don't use shield apron?		
Not available	73	65.2
Practice assessment	**Frequencies**	**Percentage**
How many times you use c-arm fluoroscopy per week?		
1-3 times	66	58.9
Do you wear shield apron during procedure?		
Sometimes	56	50.0
Do you wear thyroid apron during procedure?		
Never	75	67.0
Do you wear lead glass during procedure?		
Never	101	90.2
Do you use dosimeter during procedure?		
never	99	88.4

Regarding participant attitude to radiation safety measures, just a 57.1% of the responders indicated that they would attend a lecture on radiation hazards in the future. While 25.9% were unsure and 17.0% stated that they would not attend. 83.9% indicated that they believe using C-arm radiation without protection measures is harmful. While 14.3% were unsure and only 1.8% (2 participants) stated that they do not believe it is harmful. The majority, 65.2% of responders indicated that the reason medical staff don't use shield aprons is that they are not available, while 30% said it is uncomfortable.

Regarding the participant practice towards radiation safety, the majority, 58.9% (66 participants), indicated that they use C-arm fluoroscopy 1-3 times per week, 11.6% (13 participants) reported using C-arm fluoroscopy less than 1 time per week. Additionally, 29.5% (33 participants) reported using C-arm fluoroscopy more than 3 times per week. In terms of shield apron usage during procedures, 25.0% indicated that they always wear a shield apron, 50.0% wear it sometimes, 16.1% wear it often, and 8.9% never wear it. When it comes to wearing a thyroid collar during procedures, 8.0% always wear it, 17.0%wear it sometimes, 8.0% wear it often, and the majority (67.0%) never wear it. the majority of participants 90.2% (101 participants) and 88.4% (99 participants) reported never wearing lead glass or using a dosimeter during procedures respectively (figure 1).

As we took 50% as cutoff value of participants answers for assessment of knowledge, attitude and practice, we found that 65.2% had inappropriate knowledge, 92.9% of participants reported engaging in unsafe practices, 60% of participants had positive attitude toward radiation protection practice.
There are no statistically significant correlations between specialty and knowledge or attitude, however there is a positive correlation between specialty and practice for vascular surgeons (r = 0.24 p= 0.06), and negative correlation between specialty and practice for anesthesia specialists (r= 0.20 p = 0.11).



DISCUSSION

The results from the current study indicate a significant knowledge gap among the participants, with 65.2% demonstrating "inappropriate" knowledge regarding radiation protection. This is consistent with the findings from the Sabha University study, which reported that only 27.2% of the participants had adequate knowledge about radiation safety(15). Interestingly, the current study found that most participants (70.5%) did not know the type of C-arm unit used, while 75.9% were unaware of the radiation exposure levels during each procedure. Similarly, the Sabha University study found that 78.8% of participants did not know the annual dose limit for occupational radiation exposure(15). These knowledge gaps underscore the importance of providing clinicians with comprehensive education on radiation protection principles, equipment, and safety protocols.
The current study found that 60% of participants had a positive attitude towards radiation protection practices, which is slightly higher than the 52.9% reported in the Sabha University study(15). However, both studies identified a disconnect between the clinicians' attitudes and their actual practices, with the current study finding that 92.9% of participants engaged in unsafe practices where only 25% of participants always wore a shield apron, while the majority (67%) never wore a thyroid collar during procedures. Similarly, the Sabha University study found that only 16.9% of participants always wore a lead apron, and 84.7% never used a dosimeter(15). The reasons for this attitude-practice gap needs further investigation. Factors such as availability of protective equipment and workplace culture may contribute to the suboptimal translation of positive attitudes into safe practices.
Similarly, a study conducted at Adama Hospital and Medical College in Ethiopia assessed the knowledge, attitude, and practice of healthcare providers towards radiation hazards. The study revealed considerable deficiencies in knowledge and practices related to radiation protection among healthcare workers, underscoring the need for enhanced education and training programs to mitigate radiation risks(16). For instance many studies emphasis the needs for further measures to ensure the proper radiation protection measures, for example study by Jenkins et al. (2021), intraoperative risks of radiation exposure for surgeons and patients were highlighted, emphasizing the need for stringent radiation protection measures during surgeries(4). Another study by Bratschitsch et al. (2019) compared radiation exposure of patients and operating room personnel during spinal surgeries using fluoroscopy and navigation systems, finds that proper use of protective equipment significantly reduced radiation exposure(5),.
These findings highlight the critical need to implement quality assurance measures, ensure the availability of necessary protective equipment, and targeted educational intervention, addressing these underlying issues could help bridge the gap between knowledge, attitudes, and practice. moreover, change in medical school curriculum by adding comprehensive radiation protection education would help future healthcare providers develop a strong foundation of knowledge and best practices.

CONCLUSION

The study reveals significant knowledge gaps, suboptimal attitudes, and unsafe practice among non-radiology physicians using the fluoroscopy unite. Targeted educational intervention, increased availability of radiation protection equipment, and standardized protocols will improve these results and minimizing the risks associated with radiation exposure to both healthcare providers and patients.

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المعرفة والسلوكيات والممارسات المتعلقة بالوقاية من الأشعة بين الأطباء المستخدمين للتنظير الفلوري في مركز مصراتة الطبي، ليبيا.

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المستخلص

الهدف من هذه الدراسة هو دراسة مستوى المعرفة والسلوك والممارسة بين الاطقم الطبية في مركز مصراتة الطبي باستخدام وحدة الاشعة بالعمليات .(C-arm) أجريت دراسة مقطعية للأطباء في المركز الطبي مصراتة باستخدام استبانة وزعت على الأطباء في مختلف التخصصات التي تستخدم وحدة C-arm في غرفة العمليات. تتكون الاستبانة من 20 سؤالا تشمل أسئلة حول البيانات العامة (العمر والجنس والحالة الاجتماعية والتخصص وسنوات الخبرة)، و 5 أسئلة حول المعرفة الأساسية للوقاية من الإشعاع، و 3 أسئلة حول السلوك و 6 أسئلة حول الممارسة. . تم إرسال 177 استبانة وتم جمع 126 استبانة ، ومن ثم تم ملء النتائج في Microsoft Excel وتحليلها باستخدام برنامج SPSS. تم تحديد فجوة معرفية كبيرة بين المشاركين(n=112) ، حيث أن الغالبية تفتقر إلى المعرفة بمبادئ الوقاية من الإشعاع. وتفاوتت المواقف والسلوكيات تجاه تدابير الوقاية من الإشعاع بين المشاركين، حيث بينت نسبة كبيرة من المجيبين ادراكها بالضرر الناجم عن استخدام الاشعة الناتجة من استخدام جهاز (C-arm) في عدم وجود وقاية من الاشعة. كما أظهرت أنماط الممارسة نسبة كبيرة من الممارسات غير الآمنة. كشفت الدراسة عن فجوات معرفية كبيرة، وسلوكيات دون المستوى الأمثل، وممارسة غير آمنة بين الأطباء غير المتخصصين في الأشعة الذين يستخدمون وحدة التنظير الفلوري. ستؤدي التدخلات التعليمية المستهدفة وزيادة توفر معدات الوقاية من الأشعة وتوحيد البروتوكولات إلى تحسين هذه النتائج وتقليل المخاطر المرتبطة بالتعرض للإشعاع لكل من مقدمي الرعاية الصحية والمرضى.

الكلمات الدالة. الموقف، التنظير الفلوري، المعرفة، الممارسة، الحماية من الإشعاع.