REPUBLIC OF IRAQ

MINISTRY OF HIGHER EDUCATION

AND SCIENTIFIC RESEARCH

BABYLON UNIVERSITY

COLLEGE OF PHARMACY

A study on the effect of radiation on workers in the medical field and how to prevent it.

project Submitted to the College of Pharmacy/ Babylon UniversityIn partial fulfillment of the requirement for the degree of Bachelor in Pharmacy

By Students:

Ghada Ahmed Ashour.

Karima Hashem Kawthar

Supervised by:

Dr. Rafal Ahmed Al-Asali

بسم الله الرحمن الرحيم

(يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ)

صدق الله العلي العظيم

سورة المجادلة

الاية ١١

الاهداء

بسم الله الرحمن الرحيم

الحمد لله حباً و شكراً و امتناناً

ما كنا لنفعل هذ لو لا فضل الله ف الحمد لله على البدء و الختام

......

من قال انا لها " نالها " و انا لها و ان ابت رغما عنها اتيت بها

الى الايادي الطاهرة التي ازالت من طريقي اشواك الفشل

الى من ساندني بكل حب عند ضعفي .....

الى من رسمولي المستقبل بخطوط من الثقة و الحب...

اليكم عائلتي

اهدي فرحة تخرجي الى الانسانة العظيمة التي طالما تمنت ان تقر عينها برؤيتي في يوم كهذا .. الى امي

لأجلنا و ما عانيناه من تعب المسافة لكل من علمنا حرفا و لم يملكنا و لكنه اغنانا الى مشرفتنا و كل من ساهم في نجاحنا و تميزنا ....

Abstract

Protection against occupational radiation exposure in clinical settings is important. This paper clarifies the present status of medical occupational exposure protection and possible additional safety measures. Radiation injuries, such as cataracts, have been reported in physicians and staff who perform interventional radiology (IVR), thus, it is important that they use shielding devices (e.g., lead glasses and ceiling-suspended shields). Currently, there is no single perfect radiation shield; combinations of radiation shields are required. Radiological medical workers must be appropriately educated in terms of reducing radiation exposure among both patients and staff. They also need to be aware of the various methods available for estimating/reducing patient dose and occupational exposure. When the optimizing the dose to the patient, such as eliminating a patient dose that is higher than necessary, is applied, exposure of radiological medical workers also decreases without any loss of diagnostic benefit. Thus, decreasing the patient dose also reduces occupational exposure. We propose a novel four-point policy for protecting medical staff from radiation: patient dose Optimization, Distance, Shielding, and Time (pdO-DST). Patient dose optimization means that the patient never receives a higher dose than is necessary, which also reduces the dose received by the staff. The patient dose must be optimized: shielding is critical, but it is only one component of protection from radiation used in medical procedures. Here, we review the radiation protection/reduction basics for radiological medical workers, especially for IVR staff.

List of content

Chapter one: introduction

No.	Title	Page
1-1	introduction	6
1-2	Role of public health in radiology and radiation protection and safety of the patients and medical workers	8

Chapter two: method

2-1	**Experimental part**	11

Chapter three: results and discussion

3-1	**Results**	12
3-2	discussion	15
3-3	Conclusion	16

List of Tables

No.	Title	Page
3-1	People exposed to radiation with protective measures	12
3-2	People exposed to radiation directly without protective measures	14
3-3	normal range	14

Chapter one

1-1 introduction

Radiation safety is a concern for patients, physicians, and staff in many departments, including radiology, interventional cardiology, and surgery. Radiation emitted during fluoroscopic procedures is responsible for the greatest radiation dose for medical staff. Radiation from diagnostic imaging modalities, such as computed tomography, mammography, and nuclear imaging, are minor contributors to the cumulative dose exposures of healthcare personnel. However, any radiation exposure poses a potential risk to both patients and healthcare workers alike.[1] In the medical field, ionizing radiation has become an inescapable tool used for the diagnosis and treatment of a variety of medical conditions. As its use has evolved, so have the cumulative doses of lifetime radiation that both patients and medical providers receive. Most radiation exposure in medical settings arises from fluoroscopic imaging, which uses x-rays to obtain dynamic and cinematic functional imaging. Formal radiation protection training helps reduce radiation exposure to medical staff and patients. (2) Medical radiation protection (RP) should properly involve activities on infrastructure, equipment, QA programs, and workforce.[3] Rather than covering all the aspects of medical RP, this study focuses on radiation workers' knowledge, skills, and attitude in protecting themselves from the harmful effects of ionizing radiation

There are three basic principles of radiation protection: justification, optimization, and dose limitation. Justification involves an appreciation for the benefits and risks of using radiation for procedures or treatments. Physicians, surgeons, and radiologic personnel all play a key role in educating patients on the potential adverse effects of radiation exposure. The benefits of exposure should be well known and accepted by the medical community. Often, procedures that expose patients to relatively higher doses of radiation—for example, interventional vascular procedures—are medically necessary, and thus the benefits outweigh the risks. The As Low as Reasonably Achievable (ALARA) principle, defined by the code of federal regulations, was created to ensure that all measures to reduce radiation exposure have been taken while

acknowledging that radiation is an integral part of diagnosing and treating patients. Any amount of radiation exposure will increase the risk of stochastic effects, namely the chances of developing malignancy following radiation exposure. These effects are thought to occur as a linear model in which there is no specific threshold to predict whether or not malignancy will develop reliably. For these reasons, the radiologic community teaches protection practices under the ALARA principle

2-1 Role of public health in radiology and radiation protection and safety of the patients and medical workers:

Public health is defined as “the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society”.(4)

From the definition implies, public health should be involved in

all areas that may have any impact on human health. It can be an effort to minimize the exposure of risk factor – ionizing radiation or to deal with quality in health care – in radiology. The Public health can cooperate in obtaining the necessary information for evidence-based medicine that is an integral part of all medical disciplines, including radiology and radiobiology.

Based on the knowledge about radiation, we know, exposure of cells to any form of ionizing radiation is connected to a potential risk of biological cell damage. The main effect of exposure is molecule ionization and actions that follow, which cause irretrievable cell damage. The target molecule of ionizing radiation is the DNA molecule, but it effects also other molecules such as proteins and lipids. (5,6) The mechanisms of ionizing radiation are very complicated and consist of physical, physicalchemical, chemical and biological processes that cause the final radiobiological effect.(7)

The radiation used in medicine, represents the biggest part of the radiation that comes from artificial resources. The reason is an increasing demand for X-Ray with an accent on the computed tomography (CT) and the multidetector computed tomography, which represents 50% of the medical’ expositions. (8) The yearly rate of carried out X-Ray examinations is more than

3600 million (of which approximately 10% represent the children's expositions), 37 million examinations in nuclear medicine and 7.5 million procedures of radiotherapy. (9) It is assumed, that this number will increase due to population aging that is affected by multiple diseases and injuries. Simultaneously, ionizing radiation is being increasingly used in diagnostics in children. Child population is more sensitive to the oncogenic effects of ionizing radiation. This leads to higher risk of acute leukaemia and solid cancers. In comparable exposition parameters, the effective doses and their risks are 50% higher in children than in adults. This risk is higher especially because of the smaller bodies of children and the number of proliferating cells that are sensible to radiation exposure. Thanks to the longer living, the children have a higher risk of cancer caused by exposure of ionizing radiation than the adults (10,11)

Another risk group except the patients are the medical workers who work

with the ionizing radiation. They are exposed to the ionizing radiation on daily basis because of various radio-diagnostic and therapeutic interventions. These expositions are connected to various acute or late effects. (12,13) -With the aim to prevent the deterministic effects and minimizing the stochastic effects, the IRPA has created several recommendations and set dose limits that should not be exceeded. In the legislation of the Slovak Republic, these norms are defined in the Law No. 87/2018 about the radiation safety and changes and completing of some laws.

It is well known that role of the public health is to minimize the impact of risk factors and, conversely, to promote the impact of protective factors. Ionizing radiation is a factor with indispensable benefits, but with its reckless use and irrational exposures, it can lead to serious health problems. The aim of all radiological methods as well as the public health is to lower the mortality and morbidity of individual diseases and thus elongate a patient's life. The public health and the radiation protection share many of the same aims. the main aim is patient-oriented, and it is about minimizing negative biological effects of the ionizing radiation in medical examinations. The second aim is workers-oriented, who work with the source of the ionizing radiation. This means, that it is a cooperation between radiation protection, public health and occupational health.

Chapter two

2-1 Experimental part

The segment of workers in the field of medical radiation is considered important and has a large and active role in society by participating in diagnosing and treating patients despite the risks they are exposed to by practicing this noble profession.

samples were collected and examined fromBaquba 30 Hospital and Baladruz Hospital in DiyalaGovernorate for people working in the field ofradiology, magnetic 26resonance imaging, and computedtomography scan . of the samples were from thosewho adhered to the 10protection systems that includedlead bras and medical glasses, while ensuring thatthe lead door was closed and that there were no leaks.

Chapter three

Results

The results of the tests were normal, and 4 samples were from those exposed to direct and moderate radiation as a result of not closing the lead door. From lead and failure to properly adhere to prevention instructions, the results of the tests were relatively high to normal values, but the high did not constitute a danger and they were not dismissed from work.

Table 3-1:- people exposed to radiation with protective measures

N. OF PATIENTS	HB GM/DL	P.C.V %	W.B.C $\times 10^9$	R.B.C $\times 10^{12}$	ESR Mm/hr
1-	15.5	47.2	8	5.74	10
2-	15.4	45.7	8.02	5.17	5
3-	14.6	45.6	6.25	5.46	5
4-	15.2	47.5	7.41	5.39	5
5-	14.8	45.9	8.44	5.45	10
6-	14.9	45.1	8.59	5.17	5
7-	14	41.8	8.36	4.78	10
8-	15.4	45.4	6.96	5.75	5
9-	15	46.0	6.81	5.37	5
10-	15.4	44.0	5.2	5.3	10
11-	13.9	45.8	7.28	5.50	7
12-	13.9	43.1	7.2	4.9	5

13-	13.6	44	7.9	5.2	11
14-	14.6	43.6	7.59	5.28	5
15-	13.6	42.5	8.90	5.21	7
16-	12.4	36.82	5.92	4.28	10
17-	11.3	30.4	6.2	4.4	7
18-	12.0	33.6	5.52	3.79	10
19-	14.9	44.5	7.1	5.2	5
20-	13.5	43.5	8.32	5.05	15
21-	11.6	38.7	5.41	4.99	10
22-	14.7	44.5	8.20	5.58	7
23-	14	41.9	6.82	4.69	10
24-	12.1	40.9	6.78	5.18	38
25-	12.7	39.8	6.01	4.46	5
26-	14.8	45.9	8.44	5.45	5

Table 3-2 ;- people exposed to radiation directly without protecation measours

Name of test	Normal range for female	Normal range for male
1-HB g/dl	12.1- 15.1	13.8 - 17.2
2-P.C.V %	35.5 - 44.9	38.3 – 48.6
3-W.B.C cell per	500 – 11000	5000 – 10000
4-R.B.C million per microliter	4.2 – 5.4	4.7 -6.1
5-ESR (mm/hr)	Under 50 years less than 20 Over 50 years less than 30	Under 50 years less than 15 Over 50 years less than 20

Table 3-3 :- normal range

N. OF PATIENTS	**HB GM/DL**	**P.C.V %**	**W.B.C $\times10^9$**	**R.B.C $\times10^{12}$**	**ESR Mm/hr**
1-	15.5	48.1	10	5.2	10
2-	14.4	47	7.5	5.5	13
3-	16.3	50	9.25	6,6	5
4-	13.5	40.8	7.08	4.7	7

3-2 Discussions

Radiation exposure can result in many health issues, including skin necrosis, radiation burns, cataracts, hair loss, birth defects, and cancers. Although understanding of radiation safety and radiobiology has greatly increased during the past century, radiation exposure in a medical setting still remains a risk to patients and health care providers. A thorough understanding of radiation safety, including the principles of time, distance, shielding, and technique, is essential. Patient factors also are important to consider and for this reasons All health care personnel should wear lead or lead-equivalent aprons and thyroid shields. Protective eyewear also is recommended in addition to the use of protective screens. Detachable drapes suspended from the sides of the table can reduce the dose greatly to the lower extremities of health care personnel and should be used when possible. Hoods might be beneficial, but proper use of a protective screen likely offers more benefit. Protective drapes placed on the surface of the patient can reduce dose to the operator but can be expensive and can increase dose to patients. Use of radiodense gloves and caps is not recommended. Patient shielding should not be a part of routine practice, as it offers no or negligible benefit and can increase dose and compromise image quality.

3-3 Conclusion:-

As medical imaging evolves, so does the medical community’s understanding of how to protect people from ionizing radiation. The first step to optimizing safe radiation practice is educating hospital staff on radiation best practices. Each institution’s radiation safety department is responsible for educating and enforcing protective strategies. Protocol development and education strategies have been effective in multiple specialties. Simple interventions can play a major role in radiation dose optimization. For example, after a 20-minute video was used to educate physicians on radiation best practices, it was found to reduce median fluoroscopy time by 30% to 50%.[14] Justification, optimization, and adherence to dose limits can significantly decrease exposure when followed. Following the ALARA principle, health care workers should confirm that the benefits of the exposure outweigh the risks and strive to decrease radiation exposure as far below the dose limits as practical.

References:

1-Mitchell EL, Furey P. Prevention of radiation injury from medical imaging. J Vasc Surg. 2011 Jan;53(1 Suppl):22S-27S. [Abstract] .
2- The 2007 Recommendations of the International Commission on Radiological Protection. ICRP publication 103. Ann ICRP. 2007;37(2-4):1332. [Abstract]
3- World Health Organization. Global Initiative on Radiation Safety in Healthcare Settings: Technical Meeting Report. Geneva: World Health Organization; 2008.
4-Pongpirul K, Lungren MP. Public Health and International Epidemiology for Radiology. Radiology in Global Health. Springer, New York: 2014
5-Cabanekov H. [Ionizing radiation and health risk].[in Sovak]. XI. Banskoštiavnickdni: Bansk Štiavnica, 2009. Accessed: January 28, 2021
6-Domenech H. Radiation Safety. Management and Programs. Cham: Springer: 2017.
7-Podzimek F. 2015. [Radiological physics (Physics of ionizing radiation)].[Book in Czech]. Praha: ČVUT: 2015.
8-Paolicchi F, Miniati F, Bastiani Let al. Assessment of radiation protection awareness and knowledge about radiological examination doses among Italian radiographers. Insights Imaging 2016;7:233–42.
9-WHO. Global initiative on radiation safety in healthcare settings. 2008. Accessed: January 28, 2021o
10-Ivanov VK, Kasjcheev VV, Chekin SYet al. Estimation of risk from medical radiation exposure based on effective and organ dose: How much difference is there? Radiat Prot Dosimetry 2013;155:317–28

11-Ivanov VK, Tsyb AF, Mettler FAet al. Methodology for estimating cancer risk of diagnostic medical exposure: with an example of the risks associated with computed tomography. Health Phys 2012;103:732–9

12-Gerić M, Popić J, Gajski Get al. Cytogenetic status of interventional radiology unit workers occupationally exposed to low-dose ionising radiation: A pilot study. Mutat Res 2019;843:46–51.

13-Reeves RR, Ang L, Bahadorani Jet al. Invasive cardiologists are exposed to greater left sided cranial radiation: The BRAIN Study (Brain radiation exposure and attenuation during invasive cardiology procedures). JACC Cardiovascr Interv 2015;8:1197–206

14-Barakat MT, Thosani NC, Huang RJ, Choudhary A, Kochar R, Kothari S, Banerjee S. Effects of a Brief Educational Program on Optimization of Fluoroscopy to Minimize Radiation Exposure During Endoscopic Retrograde Cholangiopancreatography. Clin Gastroenterol Hepatol. 2018 Apr;16(4):550-557