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The Amount of Receiving Radiation of Radiology Staffs in Imam Reza Hospital of Kermanshah (Iran)

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Abstract: The development of science and technology with the use of radioactive sources for medical, industrial, agricultural and military research purposes has increased the risk of radiation receiving to workers and the general public. The use of ionizing radiation in medicine for diagnosis, treatment and research is an inevitable matter. The purpose of this study was examining the amount of receiving radiation of radiology staffs in Imam Reza Hospital of Kermanshah. The study was a cross-sectional study that aims to measure the amount of receiving radiation of radiology staffs in Imam Reza Hospital of Kermanshah in 2013. The instrument used in this study was geiger-muller counter of gamma-scout-model made in Germany. This device has a digital display and show the receiving dose based on micro sievert per hour. The results of this study showed that in none of unites, the receiving radiation didn't exceed the threshold. Also the maximum receiving dose is related to the nuclear medicine which was at the time of radiopharmaceutical discharge and minimum receiving dose relates to radiology unit in the unit that simple photos was taken. The highest amount of radiation in the radiology unite is related to X-ray fluoroscopic image with 0/55 micro Sv per hour and the lowest amount relates to simple photo with 0.06 micro Sv per hour. Receiving radiation's amount at the location of staff in CT was 636, Crushers was 396 and nuclear medicine was 360 micro Sv per year. Overall, results of the study showed that none of the investigated units, the receiving radiation was not exceeded the threshold. The staff's receiving dose at this medical center was at standard level. So, it is necessary to accomplishsafety workshop and radiation protection in order to more regardthe safety considerations at the radiography unites.

Key words: Receiving radiation, radiology, hospital, Geiger-Muller, Iran

INTRODUCTION

At the hospitals, in order to detect and identify diseases, radiography is used which actually is one of the most useful type of ionizing radiation applications in medicine (Abedi *et al*., 2011). The use of ionizing radiation in various fields, particularly medicine has played a huge role in human health, for example, in each medical center which equipped with the radiology, radiotherapy, nuclear medicine unites, which painlessly perform valuable aid in the diagnosis and treatment of diseases butbesides such advantage, if the radiation is exceed the threshold can impose catastrophic consequences on human body (Ali *et al*., 2014). One of the environmental hazards, is ionizing radiation which can cause serious, irreversible and non-treatable damages, in the manner of those who deal with radiation or those who refer for diagnosis and treatment (Bashori, 2001). One of the hospitals' uniteswhich support the early diagnosis and continuing the treatment isradiography department that by providingimaging services help the patients' improvement and in fact is one of the diagnostic parts which a part of fixed capital and force human of hospital is focused on this unit (Archer, 1995). On the other hand, by excessive

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receiving of radiation in patients and visitors, it may occur an unforeseen event equal to an accident. So, as soon as the human realized that if using the radiation uncontrollably, it will be very harmful (Bashore and T, 2001). Statistics show that >80% of patients admitted to hospitals are in need of a radiography (Borhani and Alizadeh, 2003). The extensive use of ionizing radiation and radioactive materials cause different injuries for those who has been received unwanted dose of radiation. (Byoung-il *et al*., 2011; Yukihara and Mckeever, 2011). Based on basic safety standards, it is required to ensure the correct assessment of occupational receiving radiation in various radiation applications, such assessment according to the type of activity using calculations by environmental measurement and calculation or only be done through the use o f personal dosimeter, (Ebrahimi *et al*., 2016; Farzianpour *et al*., 2014; Gahrobi, 2009) the lack of radiation protection and the lack of awareness about the quantity of receiving personnel doses while working in the laboratory with different radiation, can cause irreparable harm to the experimenter and be dangerous (Gustafsson and Mortensson, 1983). All of radiographic centersare used from ionizing radiation. Although the use of this radiation in diagnosing the diseases is very effective but in view of the protection against radiation is a source of potential risks and the radiations protection issue makes concern to many radiographers and because of concerns about the complications caused by radiation which makes the person leave the work. Medical supervision has an important role in the protection of workers against radiation damages. Medical supervision is determining the right lace for radiographer employees according to health records and their physical condition and their past history of receiving radiation. Swelling of the skin, cataracts and effects on the hematopoietic system including blood disorders, including leukemia are the complications of radiation exposure. By controlling the health records in order to know of the individual dosimetry and performing medical examination can identify flaws and by fixing them, take a step toward the development of personnel radiation protection (Habibi *et al*., 2008; Zakova, 2001). Contact with excessive amounts of ionizing radiation can effect on gastrointestinal tract, central nervous system and ultimately affect the whole body or its effects may appear in the next generation (Hollins, 1990) international commission of radiation protection recommends that each of receiving radiation should consider any economic and social factors reduced drift "As Low As Reasonably Achievable (ALARA) (IAEA, 2011). The philosophy" as low as reasonably achievable" means that the less amount ofreceiving radiation is reasonable and feasible. This means that the radiology tests should be performed in such a way that the required information is achieved to the patient with minimal radiation risk (ICRP, 1990). Given the importance of the matter, this study was conducted to examine the amount of receiving radiation of radiology staffs in Imam Reza Hospital of Kermanshah

MATERIALS AND METHODS

The current study is a cross-sectional study was conducted to examine the amount of receiving radiation of radiology staffs in Imam Reza Hospital of Kermanshah. At first, all Imam Reza Hospital's radiography units which have ionizing radiation has been detected, including radiology department (the simple photo and ful photo section) division of nuclear medicine, stone crushing section, the CT scan and a section to the children who use portable devices were identified. Then after referring to the relevant sections, besides inspection the relevant unit, dosimetry with geiger muller counter of gamma-scout model which was made in Germany has been conducted and then the questionnaire relating to working hours and the number of working people completed and ultimately statistical Software of SPSS Version 16 used to perform relevant analysis.

RESULTS AND DISCUSSION

The results of dosimetry in surveyed units show in Tables 1-7. All points of dosimetry in the hospital has been at the standard level. According to Table 1, the highest obtained number is related to fluoroscopy.

In recent years, harmful effects of ionizing radiation enforced the medical community by implementing of standards or limiting exposure to patients and staff and selecting appropriate methods and familiarity with the devices, if possible, reduce the harmful effects of radiation exposure to the people. At first, radiologists and second, the staff are responsible for patient safety and this will be done by getting lower doses and produce radiographs with better quality of less radiation and avoid mistakes and repetition of radiography and reduce exposure to patients (Johnson *et al*., 2001; Lau, 2002) although, only the patient should be expose to the radiation but tests have shown that radiographer may also have caused from secondary or scattered radiation or leakage from the radiated lamp. Implementing available procedures to reduce the exposure of patients lead to exposure reduction in employees. In this direction, distance and

Table 1: Results of dosimetry at Imam Reza hospital radiology unit (obtained numbers are in micro Sv per hour)

Kind of photo	Measuring location	Final No. (Svh^{-1})	Radiation characteristic
Simple photo	The location of the operator (behind the protective glass)	0.06	
Skull photo	The location of the operator (behind the protective glass)	0.1	KV:70-MAS:250
Wrist photo	The location of the operator (behind the protective glass)	0.1	KV:50-MAS:4.5
Lung simple photo	CR operator (location of Photo printing)	0.02	KV:76-MAS:250
Color photo	behind the protective glass	0.28	
Fluoroscopy	behind the protective glass	0.55	

MAS: MiliAmpere-Second; KV: KiloVoltage

Table 2: Dosimetry results of Imam Reza hospital crusher unit (obtained numbers are in micro Sv per hour)

Measuring location	Final No. (Svh^{-1})	Radiation characteristic
Stone crusher unit (point 1)	0.05	
Stone crusher unit (point 2)	0.33	KV:80-120 –MAS:1.2
Stone crusher unit (point 3)	0.18	
Stone crusher unit (point 4)	0.11	
Stone crusher unit (point 5)	0.08	
Stone crusher unit (point 6)	0.08	

MAS: MiliAmpere-Second; KV: KiloVoltage

Table 3: Dosimetry results of Imam Reza hospital radiology CT scan unit (obtained numbers are in micro Sv per hour)

location	Final No. (Svh^{-1})	radiationMeasuring characteristic
The location of the operator (behind the protective glass point 1)	0.14	KV:120
The location of the operator (behind the protective glass point 2)	0.53	KV:120
Inside the waiting room	0.01	KV:120
The location of the operator behind the protective glass	0.07	KV:120
The location of the operator (1 meter distance behind the protective glass)	0.05	KV:120
HiLAD	0.04	KV:120
HiLAD	0.28	Duration:21.41s
HiLAD	0.07	Time:9s

KV: KiloVoltage

Table 4: Results of dosimetry in Imam Reza nuclear medicine hospital (obtained numbers are in micro Sv per hour)

Measuring location	Final No. (Svh^{-1})
The location of the operator behind the protective glass	0.17
Operator location (without patient)	0.02
Hot lab milking time	32.72
Milking (next to the generator)	14.36
Medicine discharge behind the glass	280.72
Carrying out medicine	19.9
Waste collection location	3.26
Location of operator behind the screen	0.57
Location of nuclear medicine receptionist operator	0.1
Waiting room (after injection while the patient was in the hall)	2.87
Patient	125.26

Table 5: Dosimetry results of ICU unit portable devices in Imam Reza hospital (obtained numbers are in micro Sv per hour)

Type of photo	Measuring location	Final No. ($Sv\ h^{-1}$)	Radiation characteristic
Simple photo of chest	Nursing station (3 m distance from device)	0.1	Kv:68 mas:4
PICU	Nursing station (3 m distance from device)	0.09	Kv:50 mas:0/10

MAS: MiliAmpere-Second; KV: KiloVoltage

Table 6: Dosimetry results of portable devices in ICU unit at Imam Reza hospital (obtained numbers are in micro Sv per hour)

Unit	Measuring location	Final No. (Svh^{-1})	Radiation characteristic
Simple chest radiography	Behind the screen at 6 meter of the device meters distance(thorax ICU)	0.09	Kv:66 mas:4
Respiratory ICU	5 meters distance of device screen's behind and lead robes	0.02	Kv:70 mas:4
ICU2	The location of the operator behind the screen	0.06	
Surgical ICU	7 m distance from machine	0.1	Kv:60 mas:4

Table 7: Dosimetry results of portable devices in hospital emergency department of Imam Reza (obtained numbers are in micro Sv per hour)

Measuring location	Final no. (Svh^{-1})	Radiation characteristic
The location of the operator behind the screen	0.01	Kv:62 mas:4
Nursing station, a distance of 3 meters from the device	0.41	Kv:62 mas:4

shielding are factors that have the most capabilities to provide radiation protection (Memarnia, 2007). The results of this study indicate that all measured points in terms of the receiving radiation dose are at the standard level which is one of its reasons may be the proper protection at this health center. Receiving employees dose who worked in nuclear medicine unit to other units were higher. The least receiving doses belong to staff that worked with portable devices. All radiographic staff at this medical unit had consistent university education and according to the eivazi zadeh and colleagues study, people with academic education due to the more recognition with the radiation protection rights than individuals without academic education received less radiation. Thus the necessity of radiation protection workshops for people without a college degree appears more important. In the study ,the number of working personnel in the facility are passing their internship and some had little job experience and individuals with low job experience due to less experience and high job potential than those with higher jb experience receives more radiation. In the medical center, the shifts are 12 h which of this 12 h the employees are performing radiotherapy about 5 h in this unit which during the week, they expose approximately 30 h to radiation. People with working hours exceeding 40 h per week which is unacceptable in terms of radiation labor laws than those with less 30 working hour per week receive less radiation. It should not be ignored the working hours with radiation and according to the regulations of radiation protection, working hours should not exceed 8 h per day and more than 40 h per week (Habibi *et al*., 2008) in the present study, according to the assessments, most of the staff was carried out the film badge for personal dosimeter. Also the necessitate to use of protective devices such as thyroid shield, lead gowns, goggles, particularly in angiography sectors is really important (Habibi *et al*., 2008). Radiation of diagnostic radiological equipment may cause abnormal effect on the radiographer personnel and patients. Especially when comments and recommendations of the committee called international safety and control issues (ICRP) for quantitative radiation protection devices in this section are not respected, These radiation cause maximum side effects and lead to adverse effects such as causing various cancers late radiation effects. For many years, the biological effects of radiation, especially the effects on the human body are checked and every few years, authorized recommended dose changes and pushed to the very small amount of ICRP. In accordance with the latest recommended allowable receiving radiation in workers, ICRP says that the dose should not exceed 10 micro Sv per year (Mianji *et al*., 2013). For example, the permissible equivalent dose in 1931 was 500 MSV but in 1998 was equal to 10 MSV per year. It is noteworthy that in the developed countries, the measurement is done several times per year and all the necessary tests should be done on radiographic personnel. In theresearcheswhich was conducted in the UK, the average annual dose of radiographic workers in hospitals is estimated at about 0.3 MSV (Mustafa *et al*., 1985). If quality control programs is implemented properly, valuable results such as reducing the receiving radiation in patients will be the result. As shown in various studies, by performing QC process and make the necessary corrections, patients' dose in radiological diagnosticprocedures reduced to a relatively large amount of 30-50% (Nazila *et al*., 2008). Meanwhile in a research in Iran, this issue was confirmed the QC procedures is one of the important method in reducing patient and staff dose in diagnostic radiology (Pirsaheb *et al*., 2016). One of the issues which should be noted in employees protection, which is the radiologic employees should never keep the patient while radiologic examination. To keep patients stable, mechanical devices should be used properly and in the absence of such instruments, their relatives or friend used for this purpose.

Use protective vest when using portable X-ray devices is necessary. Also creating a sufficient distance from the patient can be highly effective in protection. Radiography device should have timer, as long as the button is pressed, the action of radiating is taken and the time of exposure to radiation should be shown and the device cannot be easily operated while the radiator person is not yet out of the room (Abedi *et al*., 2012). Periodic medical examination and controlling employees against the risks of radiation are among important factors that should not be underestimated and we hope that regular and periodic supervision of hospital physics authority should be carried out (Habibi *et al*., 2008). Some, of the risk assessment methods must be used in hospital for assessing the exposure of health risk factor (Rahimi and Salar, 2006; Stewar and Bushong, 1993).

CONCLUSION

The measured results in this study showed that hospital staff's dose was at the standard level and finally it is recommended, it is necessary to improve safety level, radiation protection workshops for training all x-ray radiation workers hold to take a positive step to reduce the level of exposure of individuals or remove it.

Finally, if two major objectives inradiation health are regarded, including the reduction of possibly effects, as far as possible and preventing the definite effects of ionizing radiation.

Based on the two above objectives and by regarding three important principles in working with ionizing radiation, they ensure the safety of staff, patients and the community. These three principles are.

The principle of activity justification: Based on this principle that no work or activity with radiation and ionizing radiation should not be done unless it has a justifiable interest or income and be more than the possibility of its losing. Diagnosis of justification usually do by physicians andradiography should never be done without a physician's prescription.

The principle of radiation condition optimization: According to this principle as far as possible and not to create disorder work, radiation receiving condition is reduced.

The dose range principle: According to this principle, persons who work at medical radiation center as radiographer can receive a certain amount of radiation per year and if radiographerreceive dose of radiation more than threshold, it includes specific regulations, such as the forced leave and such dose limit exists for ordinary people but for patients by doctor's diagnosisand by the principle of defined dosejustification. we recomended effects of administrative interventions on improvement of safety and health in workplace must be done to reduced exposure of staff (Yarmohammadi *et al*., 2016).

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