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Evaluate the Radiation Exposure in X – Ray Departments and its Effect on the Radiologists in Different Babylon Hospitals

Ayad H. Khulef, Nihad, Abdulameer Salih
Department of Physics, Science College, University of Babylon, Babylon, Iraq
ayadham99@gmail.com

ABSTRACT

The effect of the X-ray radiation on the radiologists is studied in this paper, in the first step the leakage of the X –ray radiation dose inside the control and waiting room in four governmental hospitals and four private outpatient clinical were measured using Geiger counter, the measurements were taken near the X-ray machine and after the barrier and in the collider at height of one meter from the earth surface. The results in the control room shows that the leakage radiation is greater than the local standard, while in collider, all results are less than the local standard. Also the weekly and annual X-ray radiation dose was calculated, the calculated results are less than the local standard. While, in the second step the effect of X-ray radiation on the liver enzymes (AST, ALT, ALP) was studied, from the result obtained, it is clear that there is an effect of the X-ray radiation on the liver enzymes for workers exposure to radiation and the amount of effect depends upon the age and health of the workers.

Key words: X-Rays, Electromagnetic, Radiation, Dose, Liver, AST, ALT, ALP

1.INTRODUCTION

Radiation is the emission of energy in terms of particles or waves propagating through medium or space. While the term electromagnetic radiation is used when there is a continuous propagation waves [1].

Production of electromagnetic EM waves occurs if the current varies with respect to time or the charge is accelerated. EM waves consists of electric and magnetic fields perpendicular to each other and also perpendicular to the propagation of light as shown in Fig. (1) [2].

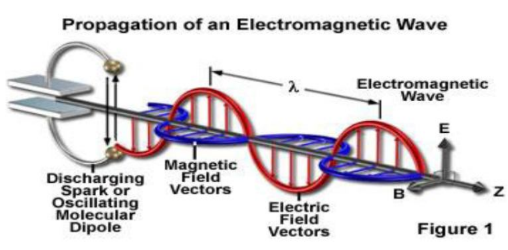

Figure 1: Electromagnetic wave

The radiation is divided to ionizing and not ionizing radiation. The ionizing radiation such as gamma rays, X-rays, and high frequencies ultraviolet (UV) frequencies have the ability to ionize any medium passing through it due to their high energy and frequencies, this process leads to remove electrons from atoms and molecules [3]. Hence, ionizing radiation can modify cells and their inherent material, which lead to harmful effects. While non-ionizing radiations cannot break the chemical bonds and ionize the material because of it is very weak energy. Visible light, microwaves, lower frequency UV, radio waves, and infrared are examples of non-ionizing radiations [4].

The harmful effects of ionizing radiation can be divided into two forms; the effects caused by radiation made mutations which is known as stochastic effect, while the other form is called tissue reactions which occurs from radiations causes cell death. In the case of X-ray imaging the stochastic effect is cancer and the deterministic effect is the hair and skin change [5].

After discovering X-rays by Roentgen in 1895 it plays a big role in many scientific developments especially in treatment and diagnostics, because of it is ability to pass through bodies. There are many fields of applications of X-rays, such as medicine, check of goods, industry, and scientific studies [6-9]. but, in fact in addition to the benefits of using X-rays, there are many harmful effects occurs during exposure to it is radiation [10-12]. As the radiologists in the radiology departments exposure to the ionizing radiation then they may get disease or injuries[13-15].

Therefore, this study will focus on the investigations of radiation in radiology departments at some hospitals and private outpatient clinical in Babylon Governorate and compare the results with the local standards.

2.MATERIALS AND METHODS

This study was done in four governmental hospitals and four private outpatient clinical and targeted all the operators (females and males) working in these medical imaging departments with ages of (21 – 40) years.

In the first step, the X-ray radiation dose was measured by using Geiger counter [16] when the X-ray machines were on and at time were patient imaging was done. The results obtained are listed in table (1) and plotted in Fig. (2) for all hospitals and private outpatient clinical, the codes (A1, A2, A3, A4) represents governmental hospitals and (B1, B2, B3, B4) private outpatient clinical and in three different places (before barrier, after barrier, and in collider). Then the results are compared with the local standards recommended by the Iraqi Ministry of Health and Environment for the X-ray radiation dose at the same places of the study, which equal to: (0.35 µsv/h) before the barrier, (0.15 µsv/h) after the barrier, and (0.11 µsv/h) in the collider.

The measured values of the X-ray radiation listed in table (1) were used to calculate the radiation dose per week by using Eq. (1)

W.D.E = D.h * No. * 7 * t ……………….. (1)

Where:

W.D.E : weekly dose equivalent
D.h : radiation dose per hour
No. : number of exposures
t : time of exposure

And Eq. (2) for radiation dose per year

Y.D.E = W.D.E * 52 ………………….... (2)

Where:

Y.D.E : annual dose equivalent
W.D.E : weekly dose equivalent

The calculated values are shown in table (2), table (3), Fig. (2), And Fig (3), in the calculation we assume that, the No. of exposures are 12 per day, and the time of exposure is 1 sec.

In the second step, the plasma levels of liver enzymes (AST, ALT and ALP) was measured for a (27) of the radiologists working in all the places mentioned in the first step of this study and exposure to X-ray radiation during their daily work, and also for (27) of the radiologists works in the control unit, and compared with the normal values for these enzymes which are, for AST is < 45 U/L, and < 40 U/L for ALT, while ALP enzyme is (21-96) U/L The study was done by collecting a (5 ml) of venous blood from each worker in a containers, then a spectrophotometer [17] was used to measure the liver enzymes activity. The results obtained are shown in table (4) and table (5).

3. RESULTS

Results of the first step of this study are shown in table (1) and Fig. (2), while tables (2 & 3) and Figs. (3 & 4) shows the calculated values for the weekly and annual leakage radiation respectively.

Table 1: X-ray radiation dose

The codes	before the barrier µsv/h	after the barrier µsv/h	in the collider µsv/h
A1	1.139	0.208	0.086
A2	1.103	0.558	0.036
A3	1.136	0.725	0.045
A4	0.997	0.090	0.036
B1	1.143	0.563	0.034
B2	1.127	0.301	0.046
B3	1.170	0.532	0.042
B4	1.092	0.708	0.033
Standard	0.35	0.15	0.11

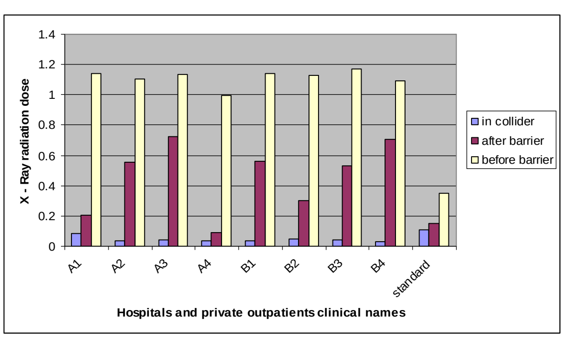

Figure 2: The values of the X-ray radiation dose for all hospitals and private outpatient clinical and local standard

Table 2: Weekly dose equivalent

The codes	The weekly dose equivalent before the barrier µsv/wk	The weekly dose equivalent after the barrier µsv/wk	The weekly dose equivalent in the collider µsv/wk
A1	0.099	0.023	0.009
A2	0.087	0.049	0.004
A3	0.039	0.027	0.003
A4	0.028	0.003	0.0011
B1	0.013	0.006	0.0015
B2	0.009	0.003	0.0012
B3	0.026	0.008	0.00091
B4	0.006	0.004	0.00032
standard	0.347	0.1487	0.0181

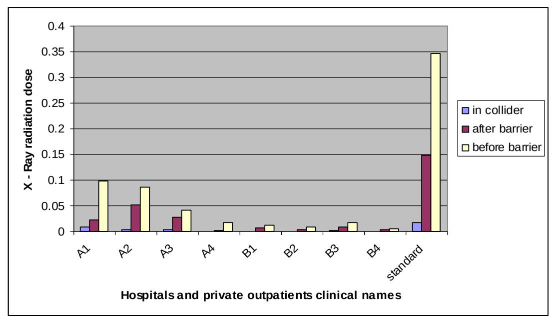

Figure 3: The weekly values of the X-ray radiation dose for all hospitals and private outpatient clinical and local standard.

Table 3: Annual dose equivalent

The codes	The annual dose equivalent before the barrier µ sv/yr	The annual dose equivalent after the barrier µ sv/yr	The annual dose equivalent in the collider µ sv/yr
A1	5.14	1.21	0.50
A2	4.49	2.70	0.19
A3	2.20	1.401	0.15
A4	0.90	0.11	0.045
B1	0.62	0.32	0.029
B2	0.51	0.14	0.031
B3	0.903	0.419	0.049
B4	0.284	0.184	0.014
standard	18.044	7.7324	0.9412

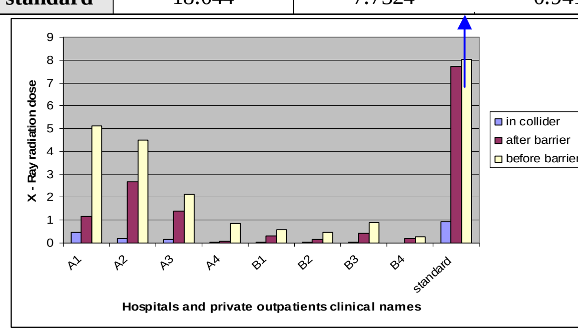

Figure 4: The annual values of the X-ray radiation dose for all hospitals and private outpatient clinical and local standard

Table 4: Plasma levels for liver enzymes (ALT, AST, ALP)

Samples	Control			Radiologists		
	AST	ALT	ALP	AST	ALT	ALP
1	8	5	65.8	7	6	75.3
2	10	6	63.7	19	16	40.2
3	17	14	55.6	15	13	53.4
4	21	9	70.5	9	7	117.5
5	35	28	83.2	32	27	170.9
6	39	34	60.7	9	6	39.6
7	13	10	59.4	10	7	65.8
8	9	6	81.6	7	4	60.23
9	12	14	47	9	7	72.87
10	12	8	65	9	6	80.86
11	13	8	53	11	7	92.27
12	15	12	65	9	7	119.08
13	17	10	74	17	14	73.48
14	23	20	68	15	13	86.76
15	18	12	60	7	6	89.48
16	31	25	80	9	7	99.43
17	13	10	96	32	27	90.77
18	18	13	41	9	7	91.96
19	26	20	65	35	28	109.44
20	17	12	57	21	15	85.27
21	29	24	96	39	34	147.23
22	23	16	88	7	6	66.06
23	12	8	90	9	6	69.07
24	28	23	70	13	10	102.30
25	22	18	94	11	7	99.56
26	12	18	31	7	6	73.32
27	8	13	96	19	16	81.83

Then, from the results shown in table (4), the average value for each enzyme is calculated as in Table (5) and plotted in Fig. (5), so as to have clear comparison between the two case.

Table 5: Average values of plasma levels for liver enzymes (ALT, AST, ALP

Liver Enzyme	Control	Radiologists
AST	18.5	14.66
ALT	14.66	11.66
ALP	69.5	87.18

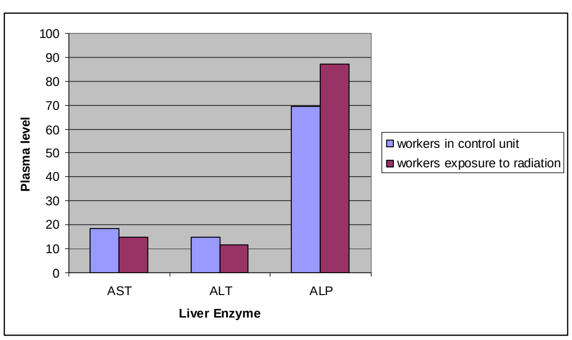

Figure 5: Average values of plasma levels for liver enzymes (ALT, AST, ALP)

4. DISCUSSION

It can be seen clearly that the measured values shown in table (1) are not the same for all the places of the study and this because of that, the daily number of exposures and the exposure time is not the same. Also the results shows that the leakage radiation dose are more than the local standard value in all hospitals and private outpatient clinical when measured in the place of the X-ray machine (before the barrier), and also in the case of (after the barrier), {except in B4 in the case of (after the barrier) were the value is less than the local standards}, which mean that all workers and patients stay in these rooms for long time and exposure to this high values of radiation may have harmful effects. Therefore, all X-ray machines must be check very well because it may radiate X-ray more than the desired values, also, the walls and doors must be shielded very well. While the measured values for X-ray dose in the collider are less than local standard in all studied places.

From table (2) and table (3), It can be seen clearly that the calculated values of the weekly and annual X-ray radiation values are less than the local standard value in all hospitals and private outpatient clinical.

The results shown in table (4) revealed that the plasma levels for the liver enzymes (AST and ALT) for all of the cases of study are under the normal levels, also, it is clear that the results are approximately the same for the radiologists and control and the difference in the results may due to the hypertension, while in the case of ALP enzyme there are some cases have plasma levels more than the normal value especially for radiologists, this mean that, there is clear effect of the X-ray radiation on the liver enzymes for the radiologists as compared to control which limit the liver activity, hence, protracted radiation exposure was found to be a risk factor for liver, which agrees with results obtained in [18,19].

5. CONCLUSION

The study cleared that the levels of leakage X - ray radiation dose are not normal and more than local standard in all the government hospitals and private outpatient clinical under study and this may cause serious harmful effects on the workers and patients health especially inside the control rooms, while in collider the results are better and in the normal range. Also, results of the effect of X-ray radiation on the livers enzymes (AST, ALT, ALP) revealed that there is clear effect especially in ALP enzyme and this effect may cause health problems if the workers are exposure to radiation for long time during their daily work time.

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