International Journal for Research in Applied Sciences and Biotechnology

www.ijrasb.com

ISSN: 2349-8889
Volume-8, Issue-4 (July 2021)

The Effect of Exposure to X-Rays on Some Blood Factors in Human Compared with Control

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ABSTRACT

Background: X-Ray usually associated with risks to the health, due to the effect of the radiation on living cells, tissues, organ, and the whole human body which end with disease.

Objective: The aim of the study is to study the changes that occur in a certain blood factors in people exposed to x-rays comparing with control group, and the effect of the exposure time on these blood factors.

Materials and Methods: Samples were collected from Ramadi Teaching Hospital (patients exposed to radiation), and from people working in the field of radiography, the blood samples were from 30 people exposed to x-rays to diagnose blood factors such as; Platelet, HB, ESR, RBC, Monocyte, Eosinophile, Basophile, Neutophile, lymphocyte, and WBS. The results were compared with control group (10 individuals). The people exposed to radiation were divided into 3 groups according to period of exposure. 10 mL of blood were collected by venipuncture and blood was transferred to a bottle containing EDTA, RBC, WBC, ESR, and other factors were measured according to protocol used by the hospital.

Results: The results shows that X-ray affect human blood cells, some blood factors was found with no significant difference between patient group with control group such as RBC, while there is a significant difference in WBS, platelets HB, and the greater the period of exposure to radiation, the greater the effect on the blood factors.

Conclusions: This study came with a lot of conclusions, among them are; no significant difference between patient group and control group in RBC, while in WBS, platelets HB there is difference, also there is a direct correlation between WBC from a side and ESR, Lymphocyte, and Monocytes.

Keywords- X-ray, blood factors, RBC, WBC, Ramadi.

I. INTRODUCTION

X-Ray, and as it was defined and agreed by the most scientists and the researchers is a high energy electromagnetic radiation that are carried by photons [(1)], which is used to generate images to any part of the body of human and to achieve this, different technologies were used such as radiography, fluoroscopy, CT Scan, as well as mammography (which use the conventional X-ray) [(2, 3)].

Usually, X-ray combined and associated with risks to the health, because the radiation is able to penetrate the tissues of the living organisms and affect them by generating free radicals [(4, 5)], broken the molecules and causing fragments, and ions which leads to cause damage to DNA as well as malfunctions in the processes of the cells, then it will influence the tissues, organs and eventually it will have an effect on the whole body which cause illness [(6)], and increased in cancer risk depending upon the dose of radiation [(7)], sex (female or male), which area of the body exposed, limit of exposure, and the age of the patient, however in some cases the radiation is used in cancer therapy (Radiotherapy) [(8, 9)].

The interaction between radiation and cells can occurs in either indirect by which the radiation interact with water inside the living cells since water represent more than 70% of cell components forming hydrogen and hydroxide free radicals which may combine with other fragments or compounds forming a harmful and toxic products [(10, 11)]. Regarding the direct interaction, the radiation interacts with chromosomes and the DNA of the cells which affect the reproduction of the cells and eventually leads to fatal. However, human cells have a great capability to repair itself from the damaged that caused by the X-ray, this indicates that not all kinds of human cells have the same sensitivity towards the radiation; some of the cells are radiosensitive while others are radio resistance [(9, 12)].

The truth that X-ray cause damage biologically to the human beings was recognized since long time [(13)], and actually, the bad effect of radiation on health was noticed and reported since 1902 [(14)], and the evidences were reported in the twentieth [(15)], and the thirtieth of the last century and it was reported as considerable until World War II [(16, 17)].

In 1996 Ward and his coworker's [(18)] finds that X-ray affect the blood and considered as a hazardous and cause decreases in the account of blood cells as well as some changes that eventually could be a reason of many diseases. Thus many studies and investigations were carried out precisely on workers who exposed to X-Ray and compared them with control (persons who were not exposed to the X-ray), and studies the relation between the dose of X-ray and its effect on the worker's health, particularly on the hematology parameters [(19, 20)].

This study was designed and carried out to find the significant changes in the hematology parameters in people exposed to x-ray, and compared the collected

ISSN: 2349-8889
Volume-8, Issue-4 (July 2021)

data with control group (people who were not exposed to x-ray).

II. MATERIALS AND METHODS

Samples were collected from Ramadi Teaching Hospital (patients exposed to radiation) as well as from people working in the field of radiography in the same hospital and from private clinics. The study included taking blood samples from 30 people exposed to x-rays to diagnose factors which are; Platelet, HB, ESR, RBC, Monocyte, Eosinophile, Basophile, Neutophile, lymphocyte, and WBS.

The people exposed to radiation were divided into sections depending on the different time period of exposure, which starts from less than 8 years, 9-13 years, and ends at more than 14 years. The study included 30 samples exposed to radiation divided into time periods, and 10 control samples were exposed to radiation.

Ten ml (10 mL) of blood was collected by venipuncture and blood was transferred to a bottle containing EDTA, red blood cells RBC and white blood cells WBC were counted with haemocytometers. Platelets count was measured by putting the blood samples in anticoagulant tube and measured them in automated platelet count device. ESR Erythrocyte sedimentation rate was measured using w. estrogen method. The sedimentation test was carried out according to ICSH 1993 [21]. All the other investigation regarding the hematology were carried out according to the protocols mentioned by Taqi et al., [22]

III. RESULTS AND DISCUSSION

Table 1 shows the mean values and standard deviation of the studied factors for the exposed persons compared to the control group.

Table 1: The mean values and standard deviation of the studied factors for (patients and control groups)

Radiation	RBC		WBC		Platelet		ESR		HB	
	Mean	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**
Exposed	4.32	1.322	3.51	1.006	120.63	6.250	8.20	2.858	10.87	0.882
Control	4.72	0.865	6.43	1.164	348.60	75.482	14.80	1.932	14.46	0.955
Radiation	**Neutrophile**		**Basophile**		**Eosinophile**		**Lymphocyte**		**Monocyte**	
	Mean	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**
Exposed	31.50	14.137	1.70	.750	1.70	0.750	14.17	3.030	6.80	1.937
Control	49.50	9.336	1.50	.527	1.50	.527	41.90	13.503	9.80	1.317

Mean difference is significant at P<0.05

The results in table 1 did not show any significant difference in the number of red blood cells when exposed compared to the control group, these findings are match with findings Moore and Ledford 1985 [23]; Suda et al., 1993 [24], Taqi et al., 2019 [22].
However, a significant decrease in the number of white blood cells (WBC) was observed in people exposed to radiation compared to control, as well as for platelets, as a significant decrease was observed in people exposed to radiation compared to the control group these findings match with the studies made by (Witas et al., 1977 [25]; Duguid et al., 1991 [26]; Talab et al., 2018 [20]). The results showed a decrease in the rate of red blood cells (ESR) in the subjects exposed to radiation compared to the control group, as well as a decrease in the concentration of hemoglobin, as well as a decrease in the number of Neutrophile, Monocytes, Lymphocyte, with no change in the number of Basophile, and Eosinophile.
Table 2 shows the values of the averages and the standard deviation of people exposed to X-rays with different exposure times

Table 2: The averages values and the standard deviation of patients exposed to X-rays with different exposure times

Duration	RBC		WBC		Platelet		ESR		HB	
	Mean	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**
Less than 8 years	4.22	1.05	4.10	.468	120.20	6.34	14.80	3.11	12.18	.48
9-13 years	4.40	1.41	3.41	.270	122.53	7.00	13.93	2.43	10.73	1.00
14 years and above	4.26	1.41	3.35	.331	118.00	4.21	13.80	3.32	10.92	.86
Control	5.72	.86	6.43	.331	348.60	75.48	8.80	1.93	14.46	.95
Duration	**Neutrophile**		**Basophile**		**Eosinophile**		**Lymphocyte**		**Monocyte**	
	Mean	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**

Less than 8 years	134.40	15.11	1.60	.894	3.20	.837	11.80	2.168	6.00	.707
9-13 years	127.80	12.81	1.87	.743	3.80	1.373	14.13	2.973	8.40	2.324
14 years and above	122.1	10.71	1.50	.707	3.20	.789	14.90	3.479	9.30	1.703
Control	49.50	9.33	1.50	.527	3.40	1.174	41.90	13.503	9.80	1.317

Mean difference is significant at P< 0.05

Table 2 shows patients group was divided into three categories according to the exposure period, which was less than 8 years, 9-13 years, and more than 14 years. The results showed that the greater the period of exposure to radiation, the greater the effect on the blood factors this finding match with studies made be Park et al., 2010 [(27)]; Zhang et al., 2014 [(28)]. With regard to WBC leukocytes, the results showed that the number of leukocytes decreased with the increase in the period of exposure to radiation. It was noticed from table 2 a significant decrease in the number of white blood cells and also in the number of blood platelets. As for hemoglobin concentration only, a significant decrease in concentration was also observed with the increase in the period of exposure to radiation, as well as a significant decrease in the rate of erythrocyte sedimentation, ESR. The results showed that there was no significant change in the number of red blood cells (RBC) according to the time period of exposure to radiation, as well as the absence of any difference in the number of acidified blood cells (Eosinophils) and basophile blood cells, but the results showed that there was a significant decrease in the number of blood cells Lymphocyte, monocytes and neutrophils All differences were at probability level P<0.05

Table 3 shows the values of the correlation coefficient between the studied factors in people exposed to x-rays.

Table 3: The correlation coefficient values between the studied factors of blood in patients' group (people exposed to x-ray)

	RBC	WBC	Platelet	ESR	HB	Neutrophile	lymphocyte	Eosinophile	basophile	Monocyte
RBC	1	0.073	0.271	0.043	0.031*	0.002	0.024	0.267	0.027	0.082
WBC	0.073	1	0.036	0.013*	0.113	0.070	0.035*	0.078	0.178	0.031*
Platelet	0.271	0.036	1	0.174	0.075	0.299	0.083	0.080	0.215	0-.120
ESR	0.043	0.013*	0.174	1	0.123	0.266	0.013	0.011	0.000	0.043
HB	0.031*	0.113	0.075	0.123	1	0.088	0.296	0.311	0.241	0.017
Neutrophile	0.002	0.070	0.299	0.266	0.088	1	.125	0.027	0.036	0.063
lymphocyte	0.024	0.035*	0.083	0.013	0.296	.125	1	0.061	0.008	0.123
Eosinophile	0.267	0.078	0.080	0.011	0.311	0.027	0.061	1	0.325	0.329
basophile	0.027	0.178	0.215	0.000	0.241	0.036	0.008	0.325	1	0.159
Monocyte	0.082	0.031*	0.120	0.082	0.017	0.063	.123	0.329	.159	1
	$x10^3/\mu L$	$x10^3/\mu L$	$x10^3/\mu L$	%	mg/dl	$x10^3/\mu L$	$x10^3/\mu L$	$x10^3/\mu L$	$x10^3/\mu L$	$x10^3/\mu L$

**P<0.05*

The results showed that there is a correlation between the number of white blood cells (WBC) and the rate of erythrocyte sedimentation rate (ESR). It was also noted that there is a correlation between the number of red blood cells and the concentration of hemoglobin HB. The results also showed that there is a correlation between the number of lymphocytes and the number of total white blood cells (WBC), as well as the case for monocytes and the number of total white blood cells (WBC).

A table showing the mean values and standard deviation of the studied factors for people exposed to x-rays only.

Table 4: Descriptive statistics

Parameter	Mean	Std. Deviation	No.
RBC	4.32	± 1.322	30
WBC	3.51	± 1.006	30
Platlat	120.63	± 6.250	30
ESR	14.20	± 2.858	30
HB	10.87	± **0**.882	30
N	131.50	± 14.137	30
B	1.70	± **0**.750	30
E	3.50	± 1.137	30

ISSN: 2349-8889
Volume-8, Issue-4 (July 2021)

Lympho	14.17	± 3.030	30
Mono	8.80	± 1.937	30

IV. CONCLUSIONS

- X-ray affect human cells, tissues, organs, and may cause fatal depending on time of exposure, the dose of the radiation and other factors.
- Blood cells affected with radiation, and some blood factors was found with no significant difference between patient group and control group in RBC, while there is a significant difference in WBS, platelets HB,
- There is a direct correlation between WBC from a side and ESR, Lymphocyte, and Monocytes.
- The greater the period of exposure to radiation, the greater the effect on the blood factors except RBC, Eosinophils, Basophiles which does not affected with exposure time.

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