

## **Ionizing Radiation Effects on Some Innate Immunity Parameters Estimated in X-Ray Technicians Occupied in Al-Muthanna Hospitals**

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### **Abstract**

This study involved investigation of X-ray technicians' immune system health concerning their innate immunity via some of related parameters estimation. Since X-ray is one of ionizing radiation types and able to induce many radiation exposure effects, a group of X-ray technicians were chosen randomly in this research from all Al-Muthanna Governorate Hospitals. A total of (60) cases involved as test groups and (29) controls were collected from people with no relation to any ionizing radiation exposure, healthy and non-smokers to compare their results with test groups. Results: results showed that there were poor supply for X-ray technician with PPE to protect them against radiation exposure; moreover that uncontrolled work with non-governmental clinics for X-ray. Innate immunity was suppressed since many parameters were suppressed. Conclusion: X-ray radiation caused suppression of innate immunity in X-ray technicians; periodic checkup should be updated and activated in Al-Muthanna Governorate.

**Key Words:** X-ray, Innate Immunity, NBT, X-ray technician, WBCs, Film Badge.

## **Introduction**

Ionizing radiation (IR) including X-ray is a suppressor factor for the immune system if the human was exposed to it over the accepted limits (Greenberger, 2009"1"). Radiation occupational represented by X-ray Technicians are in continuous exposure to IR during work (Duran, 2013 "2"). This study was designed to investigate about Innate Immunity status of X-ray Technicians using related parameters despite of the fact that they were healthy. The parameters that included in the periodic checkup of Radiation field workers; Total White Blood Cells WBCs count, Percentage and phagocytic activity for peripheral Neutrophils are the first clinical parameters to be estimated during periodic checkup (Hargreaves, 2010 "3"). These parameters can reflex Innate Immunity status since WBCs are first line of non-specific immune defense and the most affected components of the immune system upon IR exposure (Joo, 2012 "4"). Moreover the effects of IR on WBCs number, it can reduce Neutrophils phagocytic activity as proved by (Al-Hamadany, 2014 "5").

From another point, Personal Protection Equipment (PPE), are important factors to avoid negative effects of working in radiation field, like gray lab coats, special radio-resistance gloves, special armors for shielding and the most important part is film badges (Davondi, 2012 "6"). Film Badges are the personal exposure monitoring tool which records radiation exposure and usually controlled by radiation protection center/ Ministry of Environment in Iraq as recommended by (NCRP,2016 "7"); Picture (1).



**Picture (1): Film Badge used by Radiation Technician in Gynecology and Pediatric Teaching Hospital. Al-Muthanna Governorate.**

## **Materials and Methods**

**Cases:** A total of (60) volunteers were included in this study, they were all X-ray technicians working in Al-Muthanna governorate Hospitals. They were

healthy people, adult males and females, non-smokers. Samples were taken from women not during menstruation period. Cases ages ranged between (21 and 60) years.

**Controls:** A total of (30) volunteers were healthy adult people aged (18 and 23 years) of both genders. They were healthy with no history of IR exposure. They were all non-smokers, and menstruation period was avoided in control women that involved in this study.

**Samples:** A total of (3 ml) of blood was collected from both cases and controls by venipuncture and was put in heparinized tube and gently mixed (Lewis, 2011 "8"). Also data were collected about PPE supply for each case.

**Total WBCs count:** This test was accomplished according to <sup>8</sup>, whereas; Neubauer haemocytometer chamber (Germany) was used to count WBCs after adding a special diluting fluid to blood samples, results were obtained in Cell/mL for both cases and controls.

**Peripheral Neutrophils percentage:** This test was accomplished according to <sup>8</sup>, whereas; Blood smears were prepared and stained by Leishmans' stain (Fluka, Germany). Percentages for Neutrophils were estimated using oil immersion.

**Neutrophils Phagocytic activity Detection:** This test was used for neutrophils function testing, it involves detection of respiratory oxidative burst activity in neutrophils via their ability to reduce NBT dye after mixing the dye with heparinized blood in equal volumes and deposit of dark crystals called (Formazan particles) as positive result (Edgar, 2006 "9"). Only Neutrophils were included in counting positive ratio as recommended by <sup>5</sup>.

## **Results and Discussion**

**Results:** Controls were for comparing during statistical analysis for all results and outcomes in this study. And according to (ICRP, 2013 "10"); X-ray technicians were divided into two groups. Whereas, G1 contained samples of technicians whom employment years were less (and/or) equal to (5) years, and contain (23) persons, and G2 contained cases of occupational of more than (5) years employment in radiation field, and contain (37) persons.

This research was accomplished during 2015, ages ranged for cases and control between (21-60) years with a mean (35.9 years). There were (60) adults males and females as test cases of X-ray technicians from the total (89). The most obvious notification that recorded was that most of technicians involved did not flow the periodic checkup since more than year and a half, moreover that; (36) technicians (60 %) from the total (60), have

no license (film badge) to work legally in radiation field as X-ray technician as recommended by the ministry of health and Environment in Iraq.

Another notification recorded during samples collection; despite that there were no clinical signs appeared on all technicians involved in this study, there were some indicators of radiation exposure consequences like hearing impairment, general body weakness, hair falling and pale faces in both technician's genders.

The worse note recorded is that near than a quarter of them (28.5%) were working in non-governmental clinic for X-ray photography after their shifts in the governmental hospitals end. That caused a serious consequence on their immune system as the coming results illustrated.

In addition there were no radiation protection equipment supplied for X-ray technicians like (special gloves and gray lab coats) and even sometimes had no film badge, whereas there were only (48.4%) had film badge and nearly half of them; their film badges were old and not updated since long times.

Total WBCs results after performing statistical analysis illustrated that there was no significant differences between G1 and G2 values each with controls for the results of both genders, despite that there were 25% values among cases recorded as decreased but that diminishing was insignificant concerning both genders. Table (1 and 2). This parameter values are usually affected by gender; hence results for each gender were treated statistically as separated.

**Table (1): Total W.B.Cs Count for Females (Cases and Control)**

No.	Group	Mean ( $10^3$ ) $\pm$ SE
1	Control	8.48 $\pm$ 0.08
2	G1	8.61 $\pm$ 0.10
3	G2	8.49 $\pm$ 0.16

*(M  $\pm$  SE): Mean  $\pm$  Standard error: mean (Cell/mL)  $\times 10^3$*

**Table (2): Total W.B.Cs Count for Males (Cases and Controls)**

No.	Group	Mean( $10^3$ ) $\pm$ SE
1	Control	8.38 $\pm$ 0.05
2	G1	8.59 $\pm$ 0.06
3	G2	8.46 $\pm$ 0.08

*(M  $\pm$  SE): Mean  $\pm$  Standard error: mean (Cell/mL)  $\times 10^3$*

Neutrophils count results revealed significant differences at level ( $p \leq 0.05$ ) upon statistical analysis of G1 and G2 results with controls. Whereas,

G1 results decreased significantly at level ( $p \leq 0.05$ ) as compared with controls and G2 results, while G2 values decreased significantly at level ( $p \leq 0.05$ ) comparing with controls, but increased significantly at level ( $p \leq 0.05$ ) comparing with G1. Table (3).

**Table (3): Neutrophil percentages obtained for all Cases and Controls**

No.	Group	Mean $\pm$ SE
1	Control	57.93 $\pm$ 1.07
2	G1	51.62 $\pm$ 1.89 <sup>*a</sup>
3	G2	54.62 $\pm$ 1.33 <sup>*</sup>

*\*: refers to significant differences at level  $P \leq 0.05$ .*

*a :refer to significant difference comparing with the other test group.*

*(M  $\pm$  SE): Mean  $\pm$  Standard error.*

Neutrophils Phagocytic activity represented by NBT positive outcomes showed a significant decrease in G1 values at level ( $p \leq 0.05$ ) comparing with controls. Also G2 values decreased significantly at the same level comparing with controls. Moreover that; G2 values decreased significantly at the same level of significance comparing with G1 values.

Whereas; there were (51) cases (85%) from the total (60) X-ray technicians had levels below normal range. All controls recorded normal values, and no elevated value recorded in all technicians. Normal reference range depended was (60-75 %) as in <sup>5</sup>.Table (4); Picture (2).

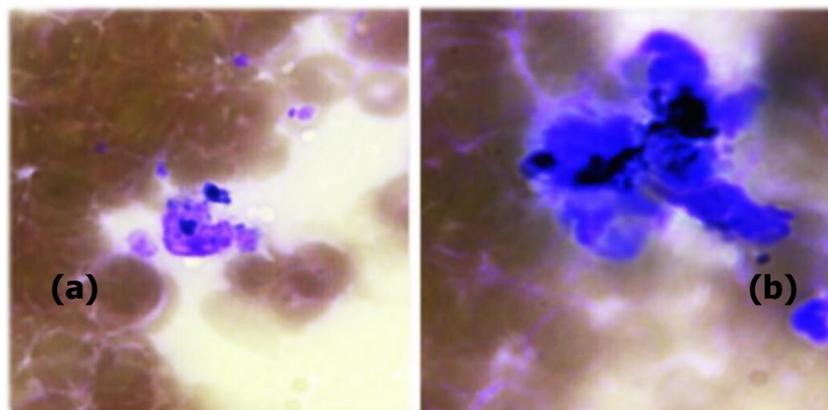
**Table (4): Positive NBT Percentages obtained for all Cases and Controls**

No.	Group	Mean $\pm$ SE
1	Control	70.20 $\pm$ 1.24
2	G1	55.00 $\pm$ 2.72 <sup>*</sup>
3	G2	39.69 $\pm$ 1.80 <sup>a</sup>

*\*:refers to significant differences at level  $P \leq 0.05$*

*a: Refer to significant differences comparing with the other test group*

*(M  $\pm$  SE): Mean  $\pm$  Standard error.*



**Picture (2): Heparinized Blood Smear for NBT Test, under Oil immersion X 100, (a) shows single cell reaction while (b) represent chemotaxis process.**

Despite of that there were no significant differences obtained during comparing G1 and G2 results with control's, there were 15(25%) from total (60) recorded individually with diminished levels comparing with control and normal accepted values. This result was expected due to radiation exposure effects.

**Discussion:**

Concerning total WBCs count, the scientist (Meo, 2004 "11") in his article classified X-ray technicians in groups, less than 5 year occupation and more than 5 years, he also found that there were no significant decrease obtained when comparing total W.B.Cs results with controls, but in general his research outcomes showed decrease in total W.B.Cs count due to radiation exposure. And that is consistent with our result for the present study.

The scientists (Mohammed, 2014 "12"), and his colleagues studied the effects of X-ray exposure in technicians occupied in different hospitals in Diyala/ Iraq. They found that there were no significant difference between occupational and controls and attributed that to the ability of hematopoietic system for fast recovery in short period upon radiation exposure and this opinion supports our results.

These findings are the same of (Davondi, 2012 "13"), they investigated hematological parameters change in radiation field workers blood and found that there were no significant differences between mean values of workers and controls despite of the decrease in WBCs count individually, these finding are the same of the present study.

Neutrophil outcomes cleared that acute exposure to X-ray as in G1 group caused significant decrease in values while chronic exposure as in G2 group caused significant decrease comparing with controls but, the levels were increased significantly comparing with G1, this outcome can be

explained as the acute radiation effects on the hematopoietic system as stated by <sup>8</sup>, they expounded acute radiation effects and included neutropenia as a symptom.

Radiation can cause decline in granulocytes count after initial exposure as stated by (Prabhu, 2015 "14").

In the study of <sup>5</sup>; neutrophil relative numbers were decreased after exposure to radiation source during an in vitro irradiation of human blood experimentally.

Akleyev, 2014 "15", presented chronic radiation syndrome symptoms and sorted out that neutrophils had the highest sensitivity cells among blood cells to radiation exposure, also he recorded a significant decrease in these cells relative numbers during both acute and chronic exposure to radiation but he stated that; with time when the radiation exposure become chronic the levels of neutrophils are recovered slightly but the phagocytic function still deficient. That is completely in agreement with our results for the present study.

Granulocyte colony stimulating factor (G-CSF) was suggested as a treatment for children with cancer receiving radiation therapy which causes Myelosuppression leading to neutropenia, that suggestion was presented by (Marks ,1992 "16"), this scientist and his colleagues explained the decline in blood cells including neutrophils as a result of bone marrow suppression leading to decrease neutrophils production, especially neutrophils which are the most sensitive W.B.C to radiation exposure regardless high or low dose of radiation, and that is consistent with the present study results.

Neutrophils function was obviously diminished as the present study results showed, all technicians mean values decreased significantly with an obvious relation to radiation exposure.

Moreover that, chronic radiation effects were more intense comparing with acute as the significance of decreasing in mean values for G2 group results comparing with G1group mean value, and that can be a consequence of radiation accumulation in human body upon continuous exposure to X-ray during work.

These results are highly supported by many previous researches, (Thomas, 2008 "17"), found that neutrophils function were suppressed by irradiation with X-ray applied on human blood sample.

The author <sup>11</sup> stated that neutrophils phagocytic activity for X-ray technician was significantly decreased comparing with controls and attributed that to radiation effects on free radicals system of these cells used for killing pathway during phagocytosis process.

The scientist <sup>15</sup> explained chronic radiation effects on neutrophils and monocytes by effecting on lysosomal component leading to suppressed phagocytic function obviously, and that is in agreement with the findings of the present study.

In the study of <sup>5</sup>; it was found that irradiation of neutrophils in human blood samples caused suppression in NBT reduction ability; hence phagocytic function inhibition resulted; and attributed that to early apoptosis induction.

As conclusion X-ray radiation caused suppression of innate immunity in X-ray technicians; periodic checkup must be updated and activated in Al-Muthanna Governorate.

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