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Radiation effects on blood cells among radiological employees in Benghazi hospitals

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التأثيرات الإشعاعية على خلايا الدم لدى العاملين في الأشعة بمستشفيات بنغازي

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الملخص:

يُعد موظفو الأشعة الذين يتعرضون بشكل مفرط لأشعة إكس أكثر عرضة للإصابة بأمراض خطيرة قد تهدد حياتهم، وغالبًا ما تكون هذه الأمراض مرتبطة بالجهاز الدموي. ومن المعروف أن الجهاز الدموي حساس جدًا للإشعاع، وقد يُستخدم تعداد الدم المحيطي كمؤشر بيولوجي على هذا النوع من الضرر.

هدفت هذه الدراسة إلى تحديد تأثير الإشعاع على مكونات الدم، ومدى ارتباط هذا التأثير بمدة العمل في مجال الأشعة. أُجريت الدراسة في قسم أمراض الدم بمدينة بنغازي خلال عام 2021، واشتملت على مجموعتين: مجموعة من 37 عاملاً ومجموعة ضابطة مكونة من 37 فني أشعة يتمتعون بصحة ظاهرة (23 ذكرًا و14 أنثى)، تتراوح أعمارهم بين 20 و70 عامًا، تم اختيارهم عشوائيًا من أقسام الأشعة في مستشفيات مختلفة بمدينة بنغازي. يعمل هؤلاء الفنّيون لمدة 8 ساعات يوميًا، خمسة أيام في الأسبوع.

أظهرت الدراسة عدم رصد فروقات وفقا للدلائل الاحصائية بين المجموعتين في جميع مؤشرات الدم، باستثناء تركيز الهيموغلوبين الكروي الوسيط (MCHC) ، حيث لوحظ تباين بين المجموعتين، إذ كانت القيمة الاحتمالية 0.009 (p) لدى العاملين، و0.116 لدى المجموعة الضابطة. ويشير ذلك إلى وجود علاقة بين تأثير الجرعات المنخفضة من الإشعاع والآثار المتأخرة.

أوضحت الدراسة أن التعرض طويل الأمد لأشعة إكس قد يُحدث تأثيرًا سلبيًا على دم موظفي الأشعة، الأمر الذي يتطلب وضع استراتيجية تدخليه في الصحة المهنية لحماية هؤلاء العاملين، وذلك من خلال توفير معدات الوقاية الشخصية.(PPE)

الكلمات الدالة: الإشعاع، التأثيرات، الدم، الخطر، الموظفون.

Abstract

Background: Radiology personnel subjected to excessive x-ray radiations are susceptible to develop life-threatening diseases often related with hematopoietic disorders. he inherent radiosensitivity of this system means that peripheral blood counts can function as a robust biological indicator of dose for such injury. Materials and methods: The study aimed to assess the biological impact of radiation on blood components and their correlation with the occupational tenure in the field of radiation. The investigation was conducted at the Department of Hematology, Benghazi (DHB) during 2021; included two groups involved of 37 workers and 37 non-exposed, healthy X-ray technicians for comparison (23 males and 14 females) with ages ranging from 20 to70 years, who were selected via random sampling from the radiology departments from multiple medical centers in Benghazi. These X-ray technicians had an 8-hour workday a day five days per week.

Results: The findings demonstrate that there no statistically notable difference was recorded between the two groups hematological parameters. Except for MCHC, there were statistically substantial disparities between the two groups, $p = 0.009$ for the workers and 0.116 for the control group, and this indicates that there is a correlation between the effect of low radiation dose and late effects.

Conclusions: The study illustrated that; the Chronic exposure to X-ray could lead to a negative impact on the hematological parameters of radiology workers. Necessitating an interventional occupational health strategy with the aim of protecting workers by providing the PPE.

Keywords: radiation، effects ،blood, risk ،employees.

Introduction

Radiological imaging using ionizing radiations specifically, X-rays are routinely used in every radiological department all over the world. These radiations are able to produce undesirable effects primary ion pairs i.e. positive ions and negative electrons. These are chemically active creating free radicals cause chemical bond breaking to the biological molecules of human cells. Leading to cell dysfunction (somatic effects) or triggers genetic mutations (genetic effects) .[1] These human injuries caused by ionizing radiations was reported in the literature just few months following Roentgen's original paper in 1895 that announcing the discovery of X-rays [2]. The first case of X-rays induced cancer was reported in the literature in 1902 [3]. Early studies reveal that Among human organs, the hematopoietic system is exceptionally vulnerable to the effects of radiation; exposure to ionizing radiations even at low doses, can lead to declines in circulating hematopoietic cells owing to suppressed bone marrow activity increased destruction of mature blood cells via apoptosis that indicates even at low doses can have significant adverse effect.[4]

Radiological employees over exposed to the energetic x-rays are susceptible to develop life-threatening diseases related to the blood cell production system. In view of the fact that, the hematopoietic system is highly sensitive to radiation and the peripheral blood count may well serve as a biological indicator of such damage.[5]

The enumeration of blood cells has long been a cornerstone in hematological analysis, functioning as a screening test for numerous hematological and non-hematological disease states. As a straightforward, cost-effective, and easily accessible test, blood cell count is particularly valuable for diagnostic and prognostic purposes in asymptomatic conditions, and easily accessible test, blood cell count is particularly valuable for diagnostic and prognostic purposes in asymptomatic conditions. Moreover, the examination of blood cells allows clinicians to generate a comprehensive differential diagnostic profile [6]. In healthy individuals, the blood cell count is consistent but can be altered by numerous factors, such as occupational hazards .[7]

Elevated or diminished blood cell counts, even among those who seem outwardly healthy, can provoke suspicion of underlying disease. However, the importance of blood cell count has been comprehensively analyzed in numerous studies addressing the influence of partial or total body irradiation on peripheral blood cell count, with the majority of studies concentrating on high-dose radiation exposure, either accidental or therapeutic [8-9]. Although many studies have focused on the hazards of high-dose radiation, there is a scarcity of data regarding the radiation hazards encountered by those working in clinical radiology departments. Specifically, there is a need to investigate the potential changes in basic hematological parameters, such as red blood cell, warrant further investigation as they may serve as indicators of the adverse effects of X-ray radiation. [10] The objective of this study was to determine the impact of radiation on blood components and to explore the relationship between these effects and the length of time radiological employees have worked in the field **.**

Materials and methods

Participant selection: this study was carried out in the Department of Hematology, Benghazi during 2021, Two groups were included in this study, comprising 37 workers in total participants who appeared healthy and worked as X-ray technicians (23 males and 14 females) with ages ranging from 20 to 70 years, randomly selected from radiology departments in various hospitals in Benghazi. The X-ray technicians had a work schedule of 8 h/day, 5 days a week. The length of time exposed to radiation was determined by the number of years, ranging from 1 to 30 years. A control group of 28 apparently healthy subjects (twenty-three males and fourteen females) was used for comparison. All participants filled out a questionnaire comprising anthropometric data and a consent form.

Results

This study involved seventy-four participants, including thirty-seven radiology technologists as the case group and thirty-seven non-radiated individuals as the control group**.**

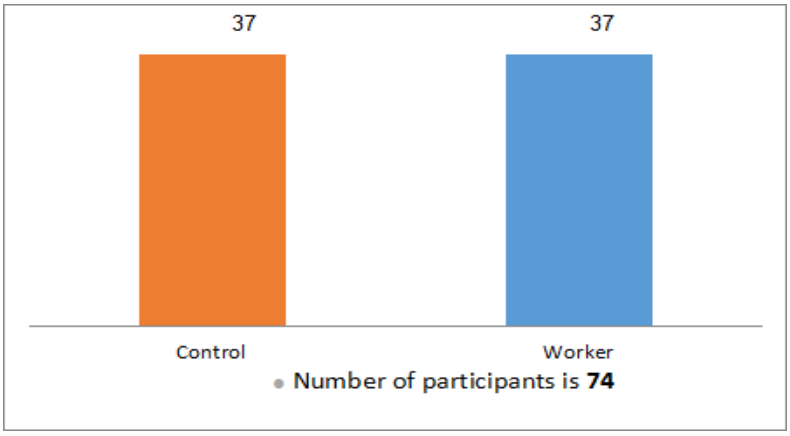

Figure 1: Illustrates the proportion of workers in the X-ray exposed and control groups.

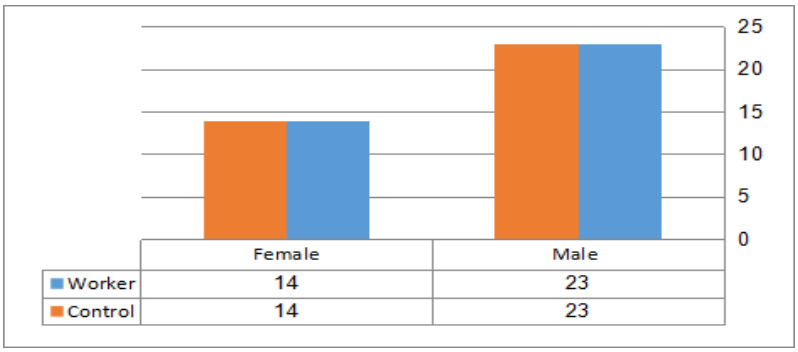

Figure 2: shows that the ratio of male was about 23%, the female 14% in worker, male 23%, and female 14% in control group. The ratio male and female in worker and control group.

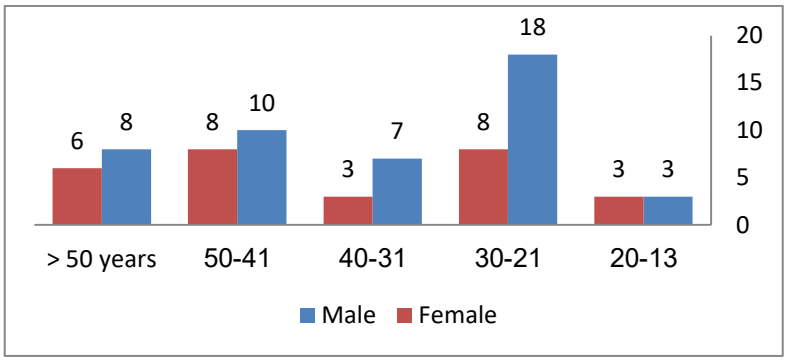

Figure 3: Shows the distribution of participants by age, with the highest frequency of participants being allocated among ages 21-30 years.

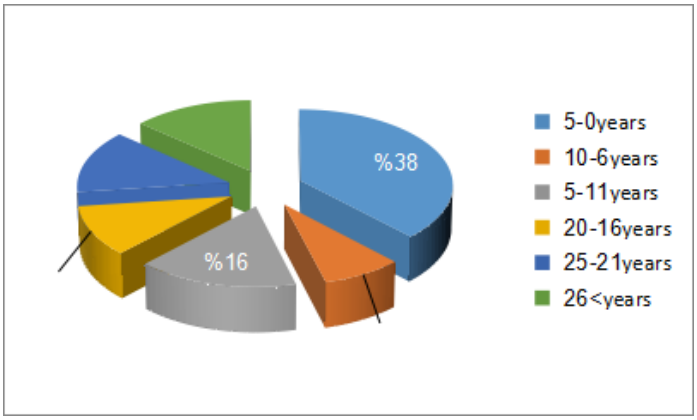

Figure 4 : Shows that the highest percent 38% had radiation exposure for 5 years or less, and a notable percentage 16% exposed from 11-15 years, 14% exposed from more than 26 years, 13% exposed from 21-25 years, 11% exposed from 16-20 years, 8% exposed from 6-10years. Indicates the ratio worker participants according to years of experience.

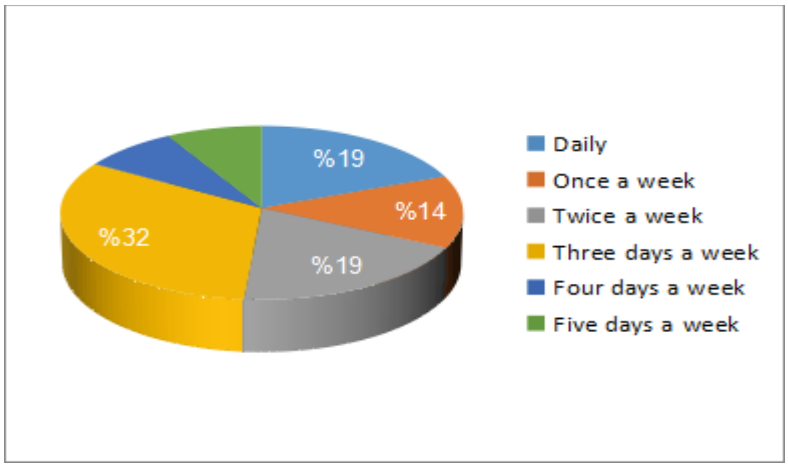

Figure 5: shows the ratio participants work many hours, the highest percentage of X-ray worker 32% exposed three days a week to X-ray radiation un their workplace, 8% exposed 4 & 5 days a week. Distribution of working hours by group: frequency and percentage.

Table 1: Comparison of blood cell count data between the control group and X-ray workers.

Significance level	PV	Mean and standard deviation	Parameters
Insignificance	0.184 0.184	7.045 ± 2.176 8.180 ± 2.017	WBC(K/μL) Worker Control
Insignificance	0.379 0.379	4.711 ± 0.403 4.622 ± 0461	RBC (M/μL) Worker Control
Insignificance	0.369 0.369	13.689 ± 1.519 13.337 ± 1.813	Hgb (gm/dL) Worker Control
Insignificance	0.256 0.260	38.45 ± 3.027 47.64 ± 48.77	HCT Worker Control
Insignificance	1.14 1.15	81.724 ± 5.662 84.254 ± 7.788	MCV (fL) Worker Control
Insignificance	0.256 0.260	29.110 ± 3.889 28.457 ± 2.180	MCH (pg) Worker Control
Significance	0.009 0.116	36.137 ± 3.889 33.416 ± 2.180	MCHC (gm/dL) Worker Control
Insignificance	0.242 0.243	239.594 ±48.272 257.405 ± 78.152	PLT (K/μL) Worker Control

This study included 74 volunteers Categorized into two groups, a cohort of radiology workers, 37 and 37 controls. This study shows that there are no statistically significant differences were observed between the two groups across all the blood parameters. With the exception of MCHC, the two groups exhibited statistically significant differences, p = 0.009 for the workers and 0.116 for the control group, and this indicates that a correlation exists between chronic low-dose radiation exposure and its subsequent effects. The CBC test can effectively monitor the overall health status of radiation workers the overall health status of radiation workers. On the other hand, it is crucial to employ complementary methods, for instance; chromosomal changes, cytokines, and interleukins evaluation, for the early identification of radiation radiation-induced pathologies.

Discussion

From early 1900s, ionizing radiations has been known as impairment effect on the hematopoiesis throw several mechanisms. Radiation exposure can damage hematopoietic stem cells and alter the function of bone marrow stromal elements. Since radiology technologists are continuously exposed to low doses of radiation, evaluating the associated risks is crucial. The current research was undertaken to evaluate the feasibility of alterations in blood cells in radiographers utilizing CBC examination and compare the outcoms with those of non-radiographers in diagnostic radiology departments of Benghazi hospital.

It is found that there is no substantial difference in the average values of blood factors between those exposed to radiation and those not exposed, which is consistent with the outcomes of studies by Sayed [21] and Salek Moqaddam [22]. Owing to long-term low-dose radiation exposure, it might be posited that the body organs have ample time to reconstruct and rejuvenate the damaged cells, as

a consequence, they remain unaffected by low-dose exposure in radiation workers. Studies performed on the blood tests of radiation workers had diverse results.

Generally, the comparison of the findings of the present study when compared with other studies, the results indicated that nearly all studies on the blood tests of radiation workers had divergent results. In this work, decreased levels of MCHC than controls ($P<0.05$). Though, the only factor that was significantly lower in the blood was identified in studies conducted by Taqi et al. [23].

Based on the current study, there is a noteworthy correlation between the effects of x-ray on MCHC of exposed group. Explicitly, the relationship between the period of experience and the radiation effects on MCHC was inspected. These results align with the findings of Shahid et al. (2014). Indeed, Shahid et al demonstrated that the long-term exposure to energetic radiation (x-rays) adversely affect blood parameter. Definitely, they found a noteworthy correlation between exposure to x-ray and MCHC, as long-term exposure results in a reduction in its count [24]. In addition to this, Nureddin et al. carried out a study in Tripoli-Libya in 2016; they found that the duration of exposure had a optimistic correlation with variations in the blood cells of exposed workers [25]. On the same manner, Shafiee et al. (2016) revealed the there is a remarkable correlation between exposure and time, which increases the duration of x ray exposure leads to increase as well as its effect of RBC increase [26].

Correlations

		DURATION	MCHC
DURATION	Pearson Correlation	1	0.007
	Sig. (2-tailed)		0.968
	N	37	37
MCHC	Pearson Correlation	0.007	1
	Sig. (2-tailed)	0.968	
	N	37	37

Conclusion

The outcomes of this study verified that the Long-term exposure to X-ray Could potentially have a detrimental effect on the workers' blood. In particular, the findings of this study suggested that there is an influence of x-ray exposure on the hematological parameters which then necessitates a proactive occupational health approach with the aim of protect the workers by supplying the PPE and in force the workers to utilize them.

Recommendations

Some points have to be highlighted from this study:

1-Justification: every exposure must be necessary and medically justified and acceptable.

2-Optimization (ALARA principle-As Low As Reasonably Achievable): radiation doses should be kept as low as possible.

3-Protective equipment's and radiation monitoring must be applied.

4-Blood test of all radiological employees including radiologists, technologists and nurses has to be maintained monthly.

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