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Original Article

Hematological profile change in radiation field workers

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Abstract

Objectives: This study focuses on the hematological parameters change and age in radiation field workers. The study aimed to identify the effect of radiation on hematological parameters and their relation to age and duration of the experience in radiation field workers.

Material and Methods: This study was conducted in the Physiology research center in collaboration with thalassemia and hemoglobinopathies center, Ahvaz Jundishapur University of Medical Sciences (AJUMS), Ahvaz, Iran during the year of 2008. In this study, a group of 60 males occupationally exposed radiotherapeutic and diagnostic workers with age ranging from 25-48 working for the last 14 years on an average were recruited. They were matched with a group of 60 healthy control subjects in the same range of age, gender and ethnic origin. Both groups met with exclusion criteria as per standard. Hematological parameters were observed by using a blood cell auto analyzer.

Results: The platelet and white blood cell count were decreased in radiation field workers with increased duration of exposure. Radiation field workers showed a statistically significant decrease ($p<0.01$ and $p<0.05$) in the mean values of platelets count and White blood cells, respectively when in comparison to controls. However, no significant difference was observed in the rest of hematological parameters between the groups.

Conclusion: The present study suggests that radiation field workers should regularly get periodic medical surveillance including hematological profile with a focus on white blood cells and platelet. These measures would help to decrease the effects of occupational hazards of radiation and detect the disease in initial stage when treatment is achievable in the workers.

Keywords: Radiation field workers; Hematological parameters; White blood cells; Platelet

Introduction

The provision of medical surveillance for radiation field workers has become a standard practice in many countries due to the widespread use of ionizing radiation and their well recognized adverse effects on health. Ideally, this should be incorporated into the occupational health service and performed by an occupational health physician with good knowledge of ionizing radiation and its health effects, and the familiarity with the work processes that involve irradiation apparatus and radioisotopes in the workplace[1]. For instance, the palpation of peripheral

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lymph nodes, the liver and spleen examination should also be performed.

The blood examination should include evaluation of hematological factors such as; white cell count (WBC), differential count and platelet count, red blood cell (RBC) count, mean cell volume (MCV), red cell distribution width (RDW), mean cell hemoglobin concentration (MCHC), haemoglobin (Hb) and mean cell hemoglobin (MCH). The presence of abnormal or excessive numbers of immature blood cells should be noted. Leukemia may be first manifest as anemia, neutropenia and thrombocytopenia. It should be noted that wide variations in blood cell counts are possible, either due to physiological variations, minor illnesses or laboratory procedures[2-3]. Workers over exposed to ionizing radiations are prone to develop life threatening diseases often related with hematopoietic system.

Given, the hematopoietic system is highly sensitive to radiation and the peripheral blood count may well serve as a biological indicator of such damage[4]. The blood cell count remains a time-honored method in the hematological analysis in healthy persons and is affected by many factors including occupational hazards[5]. The importance of blood cell count was discussed in numerous studies that showed the effects of partial or total body irradiation on peripheral blood cell count and most of the studies were focused on high dose radiation received accidentally or therapeutically[6-7].

The aim of this study was to identify the effect of radiation on hematological parameters and their relation to age and duration of the experience in radiation field workers.

Materials and Methods

Study site and population: This study was conducted in the Physiology research center in collaboration with thalassemia and hemoglobinopathies center, Ahvaz Jundishapur University of Medical Sciences (AJUMS), Ahvaz, Iran during the year of 2008. Sixty males occupationally exposed radiotherapeutic and diagnostic workers with age ranging from 2548 working for the last 14 years on an average have been included in this study. The particulars of each radiation field worker involved to include the age, sex, occupational categories, duration of involvement in the occupation, occasions for radiation exposure and its duration in hours per week, personal habits and addiction if any, health status at the time of blood collection, etc. Sixty healthy age and sex matched individuals identical to the radiation field workers in every respect but not exposed to any kind of radiation served as controls. We divided the radiation field workers based on the duration of experience to three equal groups (n = 20): 1) less than 4 years; 2) 4-9 years; 3) more than 9 years. The control group also divided randomly into three equal (n=20) groups. The study was approved by the University Hospital and Ahvaz Jundishapur University of Medical Sciences Ethics Committees, and all subjects granted informed consent to participate.

Collection of blood samples: Two ml blood was collected in sodium heparinized vaccutainer tubes through venipuncture from the workers and controls. Collected blood was transferred to a bottle containing Ethylene di-amine tetra acetic acid (EDTA) in a concentration of 1.5 mg/ml and this was used for the blood cell count. Each specimen bottle was labeled with the subject identification code number. Blood cell count was performed on an electronic cell counter (Beckman coulter counter) USA.

Exclusion criteria: Subjects with gross anemia, known history of diabetes mellitus, cardiopulmonary disease, acute and / or chronic infection, autoimmune disease and malignancy, subjects with current or previous history of smoking or addictions were excluded from the study.

Statistical Analysis

The results were computed on computer in Excel program. Statistical analysis was performed with SPSS software (v.15.0; SPSS Inc., Chicago, IL, USA). Results are given as the means ± SEM. The statistical analysis was conducted using a paired t test (two-tailed) and the level of significance was taken as a p-value less than 0.05.

Results

The mean values for age and hematological parameters for radiation field workers and controls are presented in Table 1. Radiation field workers showed a statistically significant decrease ($p<0.01$, $p<0.05$) in the mean values of platelets count and White blood cells, respectively. However, no significant difference was observed in age, RBC, MCV, RDW, MCHC, Hb and MCH between the groups. The mean ± S.E.M. of duration of exposure in radiation

field workers was 5.24 ± 0.62 years (range 1-14 years). The hematological parameters in radiation field workers assuming duration of exposure in years compared with their matched control. There was no significant difference between the mean values of the age and hematological parameters between control group and group 1. The mean ± S.E.M. of duration of exposure in radiation field workers of group 1 was 3.23 ± 0.14 years (range 1 to 4 years). There was no significant difference was observed in the mean values of the age hematological parameters between the control group and group2. The mean ± S.E.M. of duration of exposure in radiation field workers of group 2 was 5.28 ± 0.40 years (range 5 to 9 years). There were significant differences between the mean values of age and hematological parameters between control and group 3. The mean ± S.E.M. duration of exposure in the radiation field workers group 3 was 8.98 ± 0.64 years (range 9 to 14 years). Though, the platelet and white blood cell count were decreased in radiation field workers with increased duration of exposure (Figure 1). The comparisons based on the experience duration in three initialized groups have been in comparison to control group. Only platelet and white blood cell showed a significant difference and positive correlation relative to duration of experience between radiation groups and control (Table 2). The rest hematologic variables and age showed no significant changes. The white blood cell count did not show a significant ($p>0.05$) difference between group 1 and Control (The mean ± S.E.M in radiation field workers of group 1 was 7685 ± 296 µ lit compared to 7810 ± 365) , significant ($p<0.05$) difference between group 2 and control (The mean ± S.E.M in radiation field workers of group 2 was 6310 ± 183 µ lit compared to 7810 ± 365), and highly significant ($p<0.001$) difference between group 3 and control (The mean ± S.E.M in radiation field workers of group 3 was 5285 ± 152 µ lit compared to 7810 ± 365) (Figure 2). Platelet count shows a significant ($p<0.05$) difference between group 1 and Control (The mean ± S.E.M in radiation field workers of group 1 was 182510 ± 11241 µ lit compared to 252875 ± 9513), The significant ($p<0.05$) difference between group 2 and control (The mean ± S.E.M in radiation field workers of group 2 was 171875 ± 7513 µ lit compared to 252875 ± 9513), shows highly significant ($p<0.001$) difference between group 3 and control (The mean ± S.E.M in radiation field workers of group 3 was 153320 ± 10301 µ lit compared to 252875 ± 9513) (Figure 3).

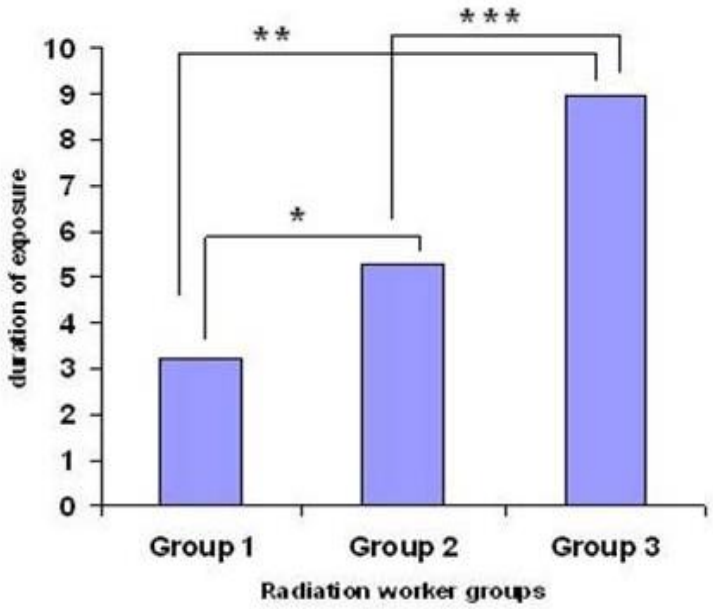

Figure 1. Mean ± SEM regarding the duration of exposure in radiation field workers of groups; * p<0.05, show a significant difference between group 1 and 2, the mean duration of exposure in radiation field workers of group 1 was 3.23 ± 0.14 years compare to 5.28 ±0.40, ** p<0.001< show a significant difference between group 1 and 3. The mean duration of exposure in radiation field workers of group 1 was 3.23 ±0.14 years compare to 8.98 ± 0.64; ** p<0.05, show a significant difference between group 2 and 3. The mean duration of exposure in radiation field workers of group 1 was 5.28 ± 0.40 years compare to 9.98 ± 0.64.

Table 1. Comparison between the age and hematological parameters in the radiation field workers and Control groups

Parameters	Control Group		Radiation field workers		
	Mean	± S.E.M	Mean	± S.E.M	p-value
Age (year)	29.45	1.07	30.10	1.03	N S
RBC (µ lit)	5525500	147732	5682000	159116	N S
Hb (gr/dL)	13.12	0.72	14.15	0.89	N S
WBC (µ lit)	7810	365	6985	196	P<0.05
Platelets (µ lit)	252875	9513	183320	13341	P < 0.01
MCV(n)	80.02	9.25	78.61	8.56	N S
MCH (pg)	25.08	4.02	23.16	3.47	N S
MCHC (g/dL)	30.01	5.24	29.23	9.19	N S
RDW (%)	23.31	2.51	19.60	5.23	N S

N S ،Non significant; Hb, haemoglobin; IDA, iron efficiency anaemia; MCH, mean corpuscular haemoglobin; MCHC, mean corpuscular haemoglobin concentration; MCV, mean corpuscular volume; RBC, red blood cells; RDW, red blood cell distribution.

Table 2. Age and hematological parameters among the radiation field workers and control groups

Parameters	Control group (n= 60)		Group 1 (n= 20)		Group 2 (n= 20)		Group 3 (n = 20)	
	Mean	± S.E.M	Mean	±S.E.M	Mean	± S.E.M	Mean	± S.E.M
Age (year) *	31.16	1.20	24.16	1.80	29.25	1.10	30.25	1.60
RBC / µ lit*	5624320	263479	5528312	159116	5524310	224479	5528312	149236
Hb (gr/dL)*	13.12	0.72	13.15	0.89	12.20	0.70	11.49	0.91
WBC / µ lit **	7810	365	7685	296	6310	183	5285	152
Platelets / µ lit**	252875	9513	182510	11241	171875	7513	153320	10301
MCV(n) *	80.02	9.25	78.61	8.56	77.01	6.20	77.61	8.01
MCH (pg)*	25.08	4.02	23.16	3.47	24.01	5.22	23.89	3.59
MCHC (g/dL)*	30.01	5.24	29.23	4.19	30.22	5.24	29.97	3.89
RDW (%)*	23.31	2.51	20.60	3.23	22.11	2.91	21.70	4.03

* N S ،Non significant; ** significant ; Group 1, less than 4 years work experience; Group 2, 4-9 years work experience; Group 3, more than 9 years work experience. Hb, haemoglobin; IDA, iron efficiency anemia; MCH, mean corpuscular haemoglobin; MCHC, mean corpuscular haemoglobin concentration; MCV, mean corpuscular volume; RBC, red blood cells; RDW, red blood cell distribution.

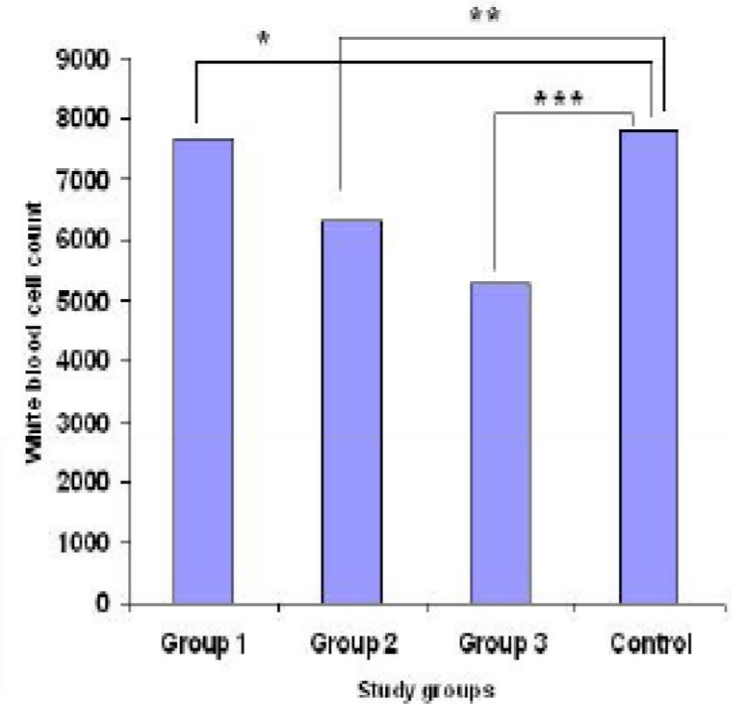

Figure 2. White blood cell count between radiation groups and control;* p>0.05, show no significant difference between group 1 and Control , The mean ± S.E.M in radiation field workers of group 1 was 7685 ± 296 µ lit compare to 7810 ± 365; ** p<0.05, show significant difference between group 2 and control , The mean ± S.E.M in radiation field workers of group 2 was 6310 ± 183 µ lit compare to 7810 ± 365; *** p<0.001, show highly significant difference between group 3 and control, The mean ± S.E.M in radiation field workers of group 3 was 5285 ± 152 µ lit compare to 7810 ± 365.

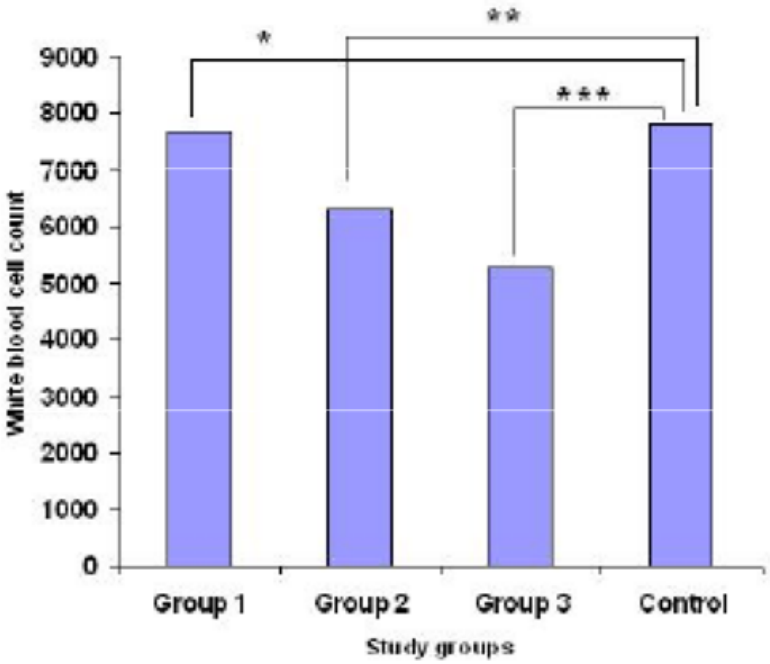

Figure 3. Platelet count between radiation groups and control;* p<0.05, show no significant difference between group 1 and Control , The mean ± S.E.M in radiation field workers of group 1 was 182510 ± 11241 µ lit compare to 252875 ± 9513; ** p<0.05, show a significant difference between group 2 and control , The mean ± S.E.M in radiation field workers of group 2 was 171875 ± 7513 µ lit compare to 252875 ± 9513; *** p<0.001, show a highly significant difference between group 3 and control, The mean ± S.E.M in radiation field workers of group 3 was 153320 ± 10301 µ lit compare to 252875 ± 9513.

Discussion

Radiation has potential effects on living cell and can make functionally abnormal cells by the free radical mechanism. Long-term exposure to radiation may affect cells and tissues and result in various adverse health effects. Keeping in view the effects of exposure to ionizing radiation, the present study incorporated basic hematological parameters count. Annual follow-up ensures the currency of the medical findings. Criteria of medical fitness for diving reflect medical standards for workers. An examination consists of the individual medical history, a physical examination including the neurological status and the assessment of the cardiovascular fitness by ECG. The respiratory system is screened by regular chest x-rays and spirometery or body plethysmography. Blood and urine samples are taken to look for abnormal hematological and metabolic conditions as well as disorders of the genitourinary system. Estimation of the blood cell counts in clinical practice is a useful screening test in routine medical check-up[8]. A high or low blood cells count even in a healthy-looking subject lead to the suspicion of disease and it should prompt further investigations[9]. The vast majority of acute or chronic inflammation or infection and most degenerative diseases are associated with acceleration or deceleration of blood cell count[10].

Numerous studies have addressed the effects of partial or total body irradiation on peripheral blood count. Rozgaj et al.[4] showed that, although occupational exposure to radiation has remained close to the natural background for the majority of the employed, but the exposed population has shown an increase in chromosome aberration frequency. Meo et al.[11] did not find a correlation between the hematological factors change and the duration of employment in a controlled area. Our study found a significant correlation between the hematological factors change especially platelet and white blood cell and the exposure duration only in radiation field workers. A possible explanation for such findings might be earlier handling radiation equipment with screens. While the depressing influence of radiation on the bone marrow is generally recognized, little is known about the radiobiology amid the biochemical disturbances of mature leukocytes and platelets in the peripheral blood that result from radiation.

Wagner et al.[12], in the experiments on phosphatase activity the leukocytes, demonstrated some of the in vitro effects of ionizing radiation on mature leukocytes and blood platelets. They showed that white blood cell seems to be a sensitive test object for radiation damage. Our studies showed significant reduction in white blood cells among radiation field workers, especially with more than 5 years experience. Meo[11], in a study on x-ray technicians showed that the mean value of platelet count was significantly decreased in x-ray technicians when in comparison to controls. However, no significant difference was observed in RBC and WBC count between the groups. Our research showed a significant reduction in white blood cells and platelet count.

In conclusion, we recommended that radiation field workers should regularly use appropriate personal protective equipments at their work site and should get periodic medical surveillance including hematological profile with a focus on white blood cells and platelet. These measures would help to decrease the effects of occupational hazards of radiation and detect the disease in initial stage when treatment is achievable in cement industrial workers.

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