

**HAEMATOLOGICAL PROFILE IN RADIOGRAPHERS EXPOSED TO LOW DOSE RADIATION**

Pramila T<sup>1</sup>, Vinay A. V<sup>2</sup>, Sindhu R<sup>3</sup>, Vastrad B. C<sup>4</sup>, Janakiraman P<sup>5</sup>

<sup>1</sup>Assistant Professor, Department of Physiology, P. E. S. Institute of Medical Sciences, Kuppam, Andhra Pradesh.

<sup>2</sup>Associate Professor, Department of Physiology, P. E. S. Institute of Medical Sciences, Kuppam, Andhra Pradesh.

<sup>3</sup>Associate Professor, Department of Physiology, P. E. S. Institute of Medical Sciences, Kuppam, Andhra Pradesh.

<sup>4</sup>Professor and HOD, Department of Physiology, P. E. S. Institute of Medical Sciences, Kuppam, Andhra Pradesh.

<sup>5</sup>Biostatistician, P. E. S. Institute of Medical Sciences, Kuppam, Andhra Pradesh.

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**ABSTRACT**

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**BACKGROUND**

The cells of the haematopoietic system are highly radiosensitive and the medical radiographers who are exposed to chronic ionizing radiation are more prone to get haematological disorders later in life. A change in haematological profile is a warning sign for development of haematological diseases later. Even though the effect of acute radiation is well known, the effect of chronic low dose radiation on haematopoietic tissue is less known. Hence this study was undertaken to find out the effect of chronic low dose radiation among radiographers, to initiate awareness among them about the radiation effects and the importance of regular screening to prevent the ill effects of radiation.

**MATERIALS AND METHODS**

The study was conducted on 20 healthy radiographers and 20 healthy, age and sex matched control group. The subjects were enrolled based on detailed questionnaire and informed consent was taken from all the subjects. The mean age of radiographers was 37.4 years and that of control was 39.4 years. The radiographers were exposed to low dose radiation for more than 5 years and the radiation dose of radiographers who participated in the study were in the range of Annual Average Effective Dose (AAED) of 0.29 – 1.91 mSv. Subjects with anaemia, cardiopulmonary diseases, acute and chronic infections, history of diabetes mellitus, auto immune disease, malignancy, and history of smoking and drug addiction were excluded from the study. Control subjects who were exposed to medical or diagnostic radiation recently were also excluded from the study. The blood cell count was performed on Beckman coulter counter. The haematological parameters measured were RBC count, WBC count, and Platelet count, PCV, MCV, MCH, MCHC, Hb, RDW and DLC.

**RESULTS**

WBC count of Radiographers was lower than that of controls and the difference was statistically highly significant ( $p < 0.001$ ). There were no statistically significant differences in the mean values of other haematological parameters. Neutrophil count was significantly decreased in radiographers when compared to control group ( $p < 0.05$ ). The other differential leucocyte parameters were not affected significantly.

**CONCLUSION**

Besides the safety measures being in place, the medical radiographers exposed to low dose radiation over a long time, should undergo periodic medical check-up including complete blood count to detect the disease earlier so that preventive measures can be taken.

**KEYWORDS**

Haematopoietic Tissue, Haematological Profile, Radiographers, Low Dose Radiation.

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**BACKGROUND**

The Haematopoietic system is highly sensitive to radiation and serves as a biological indicator of ill effects of irradiation.<sup>1</sup> The ionizing radiation penetrates living cells

making them dysfunctional or mutating.<sup>2,3</sup> Rozgaj et al showed that the exposed population has a tendency to have increased chromosomal aberration frequency.<sup>1</sup> It is well known that dividing cells of the haematopoietic system are highly radiosensitive.<sup>4</sup> Role of the functional cells of the lymphopoiesis and granulocytopenesis system is very important for immune protection against infections. Thrombocytopenesis is one of the most radiosensitive haematopoietic cell lines in humans.<sup>5</sup> Radiation injury or damage of haematopoietic system can lead to haemorrhage and anaemia.<sup>4</sup> However, these alterations are dependent on an effective radiation dose range and exposure time.<sup>6</sup> Wagner et al<sup>7</sup> demonstrated in Vitro effects of ionizing radiation on mature leucocytes and platelets. They

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*Corresponding Author:*

*Dr. Vinay A. V,*

*Associate Professor,*

*Department of Physiology,*

*P. E. S. Institute of Medical Sciences,*

*Kuppam, Andhra Pradesh.*

*E-mail: av17vinay@gmail.com*

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established that WBC is a sensitive test object for radiation damage. The lymphocytes have been found to be the most radiosensitive cells. At low doses, ionizing radiation can affect the immune system by suppressing it or stimulating it.<sup>5</sup> Meo et al<sup>8</sup> have shown that platelet count was significantly decreased in X-ray technicians.

While the depressing influence of radiation on Bone marrow is recognized, Leukaemia may manifest first as anaemia, neutropenia and thrombocytopenia.<sup>9</sup>

Health hazards from acute radiation dose impacts of radiations are although, well documented but there is a little concern and unawareness in such workers related to the impacts of chronic low-dose regular or periodic radiation exposure.

Medical radiographers exposed to low dosage radiation are prone to life threatening haematopoietic diseases later. A change in haematological profile of pancytopenia is a ticking bomb to explode into serious pathology.

Hence there is a need to study haematological profile in medical radiographers exposed to radiation over a long time, besides safety measures being in place, to initiate awareness among them and further to mitigate the effects.

**Aims and Objectives**

- To determine the haematological parameters in radiographers exposed to low dose radiation.
- To compare the haematological parameters in radiographers with that of control.

**MATERIALS AND METHODS**

After obtaining approval by the institutional ethics committee, the study was conducted on forty subjects. Twenty were radiographers from Dept. of Radiology PESIMSR, and Area Hospital, Kuppam. Twenty were age and sex matched control group from general population.

**Inclusion Criteria**

- Healthy radiographers (study group) in the age group of 25-50 years, exposed to low dose radiation for more than 5 years. Radiation dose of radiographers participated in the study were in the range of Annual Average Effective Dose (AAED) of 0.29 – 1.91 mSv.

- Age and sex matched healthy control from general population.

**Exclusion Criteria**

Subjects with anaemia, cardiopulmonary diseases, acute and chronic infections, history of diabetes mellitus, auto immune disease, malignancy, history of smoking, and drug addiction.

Control subjects exposed to medical or diagnostic radiation recently.

**Method of Collection of Data**

After obtaining consent from the subjects in the prescribed format, 2 ml of blood was collected by venepuncture in EDTA vacutainer. This sample was collected at the same time of the day from each subject to avoid physiological variation. The Blood cell count was performed on 5 part haematology analyser (Beckman coulter counter) which works on the principle of Impedance conductivity and light scattering. The haematological parameters measured were RBC count, WBC count and Platelet count, PCV, MCV, MCH, MCHC, Hb, RDW and DLC.

**Statistical Analysis of Data**

The data was entered into MS Excel 2007 version and the results were expressed as mean and the comparison of mean was done using Student t –test and Mann Whitney U test was applied for the comparison of DLC parameters.

**RESULTS**

Mean age of 20 Radiographers was 37.4 years and 20 control subjects were 39.4 years. Mean WBC count of Radiographers was lower than that of controls and the difference was statistically highly significant (p<0.001) (Table -1). There were no statistically significant differences in the mean values of other haematological parameters.

On comparing the Differential Leucocyte parameters between study and control group, the levels of Neutrophils were significantly decreased in radiographers when compared to control group (p<0.05) (Table -2). The other Differential Leucocyte parameters were not affected significantly.

Haematological Parameters	Study Group (n =20) (Mean ± SD)	Control Group (n=20) (Mean ± SD)	p Value
RBC Count	5.21 ± 0.480	5.31 ± 0.430	0.520
WBC Count	7.495 ± 1.39	9.38 ± 1.90	0.000**
Platelet Count	260.3 ± 52.29	295 ± 85.43	0.129
PCV	44.75 ± 3.41	46.3 ± 3.56	0.169
MCV	87.05 ± 3.30	87.2 ± 4.06	0.878
MCH	29.22 ± 1.27	29.19 ± 1.57	0.938
MCHC	33.55 ± 0.6	33.44 ± 0.67	0.590
Hb	15.02 ± 1.24	15.47 ± 1.16	0.239
RDW	13.46 ± 0.79	13.42 ± 0.88	0.881

**Table 1. Comparison of Haematological Parameters in Study and Control Group**

\*\*p value < 0.001, statistically highly significant.

PCV – Packed cell volume, MCV – Mean corpuscular volume, MCH – Mean haemoglobin content, MCHC – Mean corpuscular haemoglobin concentration, Hb – Haemoglobin content, RDW – Red cell distribution width.

Haematological Parameters	Study Group (n =20)					Control Group (n=20)					p Value
	Mean	SD	25th Percentile	Median	75th Percentile	Mean	SD	25th Percentile	Median	75th Percentile	
Neutrophil	53.54	7.23	50.45	53.40	55.35	58.24	7.53	54.4	59.75	63.2	0.02*
Monocyte	11.48	11.03	6.15	7.90	9.15	6.65	1.92	5.5	6.5	7.95	0.08
Eosinophil	4.96	4.00	2.80	4	6.85	3.87	1.92	2	3.75	5.05	0.57
Basophil	1.17	2.20	0.4	0.5	0.7	0.46	0.37	0.3	0.4	0.55	0.09
Lymphocyte	28.95	13.86	24.4	32.15	38.65	28.82	7.55	23.40	29.6	33.05	0.30

**Table 2. Comparison of Differential Leucocyte Count in Study and Control Group**

\*p value < 0.05, Statistically Significant.

## DISCUSSION

It is well known that the dividing cells of the haematopoietic system are highly radiosensitive.<sup>4</sup> Ionizing radiations influence human health as they break chemical bonds of the molecules and damage DNA by the production of free radicals and hence proliferative cells can undergo apoptosis.<sup>10</sup> Long term exposure to even low doses of radiation can affect the proliferating cells.<sup>11</sup> Ionizing radiation exposure is sensitive for those tissues (i.e., bone marrow, the gastrointestinal tract and skin) which turnover rapidly as well as to those tissues (i.e., central nervous system, lung, heart, liver, kidney and gonads) which turnover slowly.<sup>12</sup>

Medical Radiographers (MRs) who are occupationally exposed to chronic low dose ionizing radiation are prone to develop life-threatening diseases especially related to haematopoietic system.<sup>3</sup> Peripheral blood examination may serve as a screening test for various haematological as well as non-haematological disease states. 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.<sup>13</sup>

The effect of radiation on blood cell count was discussed in many 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.<sup>14,15</sup>

Some studies have demonstrated the negative effect of low doses radiation on haematological parameters while others detect the change at genetic analysis level only.<sup>3</sup>

The results of some studies have shown that the mean differences of the basic haematological parameters including WBC, RBC, and Platelet count in Medical Radiographers showed some variations but did not reach the statistically significant levels when compared with controls.<sup>3,16-21</sup> However, some recent studies have found statistically significant difference between exposed and non-exposed subjects regarding to lymphocytes count.<sup>5,22,23</sup> These results and variations can be attributed to the performing and practices of protection standards and experience years among exposed participants.<sup>3</sup> In a study done by Meo<sup>8</sup> on x-ray technicians, the mean value of platelet count was significantly decreased in x-ray technicians when in

compared to controls. However, no significant difference was observed in RBC and WBC count between the groups.

We studied the haematological parameters in the radiographers who were exposed to chronic low dose radiation. We found a statistically highly significant decrease in WBC count in Radiographers when compared to control group (p value <0.001). However no statistically significant changes were observed in other haematological parameters.

Wagner et al<sup>7</sup> demonstrated 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. The results of our study are consistent with the results of the study done by Davoudi M et al,<sup>9</sup> which showed a significant reduction in white blood cells and platelet count among radiation field workers, especially with more than 5-years of experience. We did not find any significant reduction in platelet count among radiographers.

We also studied the effect of low dose radiation on Differential Leucocyte count and we found that the levels of Neutrophils were significantly decreased in radiographers when compared to control group. The other Differential Leucocyte parameters were not affected significantly. The results of our study are consistent with the results of the study done by Shahid et al,<sup>5</sup> who also found decreased Neutrophil count in radiographers.

Our study concludes that WBC count is decreased in radiographers exposed to chronic low dose radiation. Since the Neutrophil count is decreased in radiographers, they are more susceptible for frequent infections.

## CONCLUSION

A change in haematological profile is seen in medical radiographers who are exposed to radiation over a long time. Besides safety measures being in place, radiographers should undergo periodic medical check-up including haematological profile, to detect the changes earlier so that preventive measures can be implemented.

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