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OCCUPATIONAL RISK ASSESSMENT USING BIOCHEMICAL AND GENOTOXICITY STUDIES AMONG CONSTRUCTION PAINTERS

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Abstract:
Paint products contain several chemical compounds such as organic and inorganic pigments, extenders, binders, solvents and additives'. Painters are continuously exposed to these hazardous substances during painting of both commercial as well as residential buildings. Occupational exposure of these chemical mixtures leads to severe diseases such respiratory infections, head trauma, nasal and paranasal sinus, impair olfactory functions. The use of these toxic chemicals in paints can lead to the changes in the biochemical and genotoxicity among construction painters.

Key words: *Paint, occupational exposure, hematological, antioxidant and DNA damage.*

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INTRODUCTION:

Painting in construction industry involves exposure to large variety of irritative and allergic substances. Besides paint products and solvents, assumed to be the major chemical hazards in construction painting, painters can have considerable dust exposure, where sanding of the putty and filler is a major factor. In addition, painters also use other products containing chemicals such as paint removers and wood preservatives in their work [1]. Different types of paints used in construction work are water based paints, solvent based alkyd paints, epoxy paints, ecological paints, gloss paint and lead based paints. These types of paints contain high levels of organic and inorganic solvents and heavy metal compounds [2]. The solvent generally present in higher concentration are ethyl benzene, xylene, toluene, isopropanol, isocynate and acetone where heavy metals such as lead, cadmium and arsenic are most commonly used chemicals in paints [3]. Lead is widely used in paints which may serve as potential source of exposure among painters and long term engagement with paints leads to a serious health problem. Long term exposure to organic solvents can leads to health effects such as bladder cancer, hematological malignancies, chronic health effects, neurobehavioral disorders, headache, dizziness and sleep disorders [4].

METHODS:

The study group included 40 male workers who were engaged in painting of both residential and commercial buildings for more than 5 years. An equal number of healthy male individuals who were not exposed to any hazardous chemicals were selected as controls. Information on occupation and medical history, job description, socioeconomic status and life style of both groups were obtained through questionnaire. Subjects having a previous history of metabolic disease were excluded from the study.

2mL of the venous blood containing anticoagulant from each of the forty experimental and control groups were taken for the analysis of Hemoglobin count (Hb) and Red Blood Cells (RBC) count to the method of [5], Erythrocyte Sedimentation Rate (ESR) was determined by Westergen method of [6] and The Total Leucocyte count was determined by Truck's fluid method of [7].

8mL of the venous blood without anticoagulant was collected and serum was obtained by centrifuging the blood at 3500 rpm for half an hour. The obtained serum was used for the estimation of biochemical parameters such as Triglycerides (TG), Total cholesterol (TC), High Density Lipoprotein cholesterol (HDL-C), Low Density Lipoprotein cholesterol (LDL-C), Very Low Density cholesterol (VLDL-C), Alanine Transaminase (ALT) and Aspartate Transaminase (AST) using kits and The activity of the Superoxide dismutase (SOD), Catalase (CAT), Glutathione peroxidase (GPx) and Glutathione-S-Transferase (GST) was determined by the method of [8,9,10,11].

Heparinised venous blood containing anticoagulants were collected under aseptic condition from the five experimental and control group for the detection of DNA damage using Comet assay by method [12].

Statistical analysis using Student't' test was followed to compare the results obtained for various estimations carried out in exposed group and control group participants.

RESULTS AND DISCUSSION:

Hematological Parameters

The decrease in the mean levels of Hemoglobin (Hb), Red Blood Cell count (RBC), White Blood Cell count (WBC), and Erythrocyte Sedimentation Rate (ESR) between experimental and control group participants shows the painters are frequently exposed to organic solvents have been shown to have a deleterious effects. According to [14] the hematological parameters namely Hb, Packed cell volume, Mean corpuscular volume, Mean corpuscular Hemoglobin, Mean corpuscular Hemoglobin concentration were decreased in lead exposed Battery manufacture workers when compared to the control group. Hence the exposure of painters to these solvents might have resulted in a decreased production of red blood cells, white blood cells and platelets (Table 1and Figure 1).

Table 1: Mean Levels of Haemoglobin, RBC Count, WBC Count and ESR in Painters

S.No	Parameters	Control group n=40	Experimental group n=40	't' value
1	Hemoglobin (g/dl)	13.86 ± 0.49	12.6 ± 1.70	4.5013*
2	RBC count (x 10^6 /mm^3)	4.60 ± 0.16	4.30 ± 0.63	2.9189*
3	WBC count (x 10^3 /mm^3)	6.80 ± 0.59	4.30 ± 1.14	12.341*
4	ESR (mm/hr)	14.15 ± 4.22	4.28 ± 1.14	14.277*

* Significant at 5% level

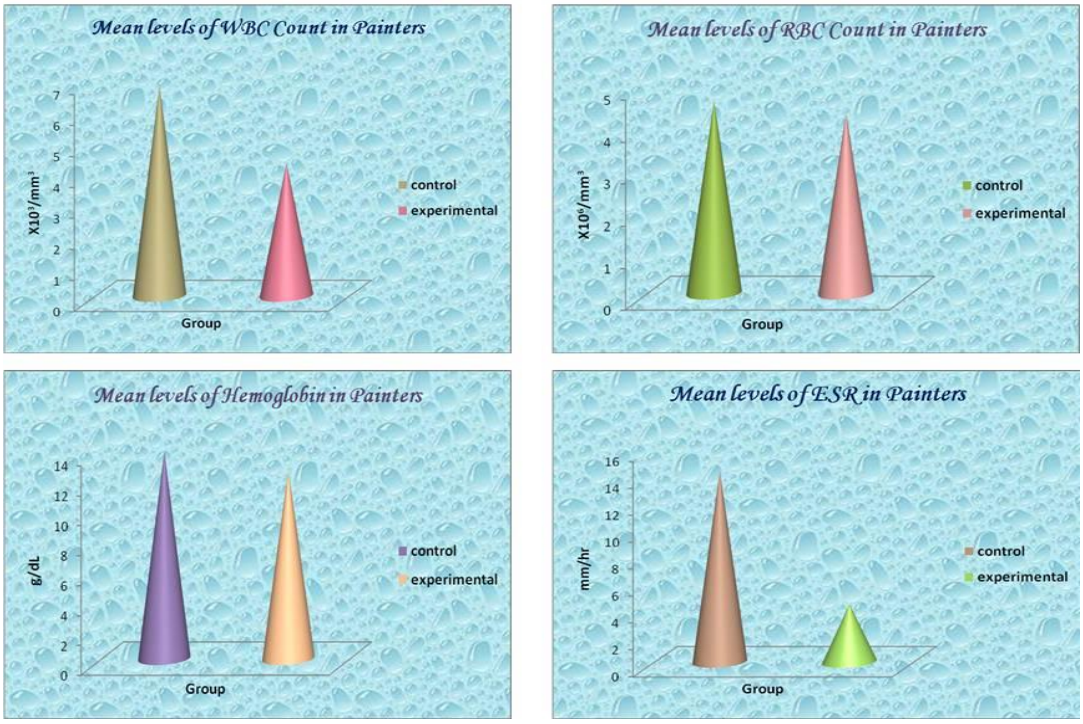

Fig 1: Hematological Parameters in Painters

Biochemical Parameters

(Table-2) depicts the increase in the mean level of HDL-C and decreased in mean levels of Triglycerides (TG), Total cholesterol (TC), LDL-C and VLDL-C between the experimental group and control group participants. According to (Table-3 figure-2), it is clear that there was no significant difference in the levels of ALT and AST between the experimental group and control group. [13] reported that the workers who are exposed to organic solvents showed elevated levels of ALT and AST. Organic solvents were the most common solvents associated with liver perturbation and solvent related nervous system disorders. Serum hepatic trasaminase ALT and AST reflect liver injury associated with necrosis and mild chronic liver injury.

Table 2: Mean Levels of Triglycerides, Total Cholesterol, HDL-C, LDL-C AND VLDL-C in Painters

S.No	Parameters (mg/dl)	Control group n=40	Experimental group n=40	't' value
1	Triglycerides	117.49 ± 22.18	104.75 ± 13.03	3.1290*
2	Total cholesterol	190.42 ± 23.63	179.30 ± 13.00	2.6060*
3	HDL cholesterol	33.15± 02.41	40.79 ± 3.92	10.496*
4	LDL cholesterol	138.28 ± 16.91	118.4 ± 11.95	6.0703*
5	VLDL cholesterol	22.91 ± 4.49	20.49 ± 2.60	2.9502*

*Significant at 5% level

Table 3: Mean Levels of ALT and AST in Painters

S.No	Parameters (U/L)	Control group n=40	Experimental group n=40	't' value
1.	ALT	20.35 ± 2.88	20.41 ± 3.29	0.0853^{ns}
2.	AST	21.50 ± 2.09	21.18 ± 3.00	0.05543^{ns}

NS- Non Significant at 5% level

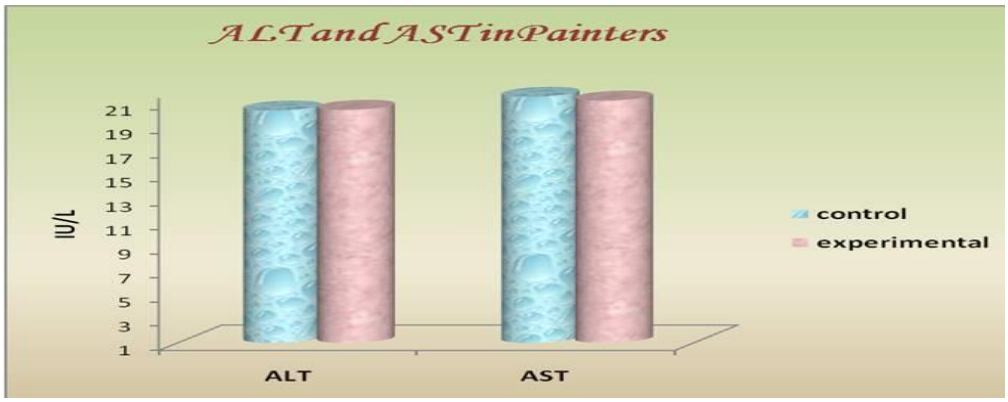

Fig 2: Liver enzyme activity in painters

Enzymic Antioxidant Activity

(Table - 4, figure-3) A significant decrease in the activities of Superoxide dismutase and Glutathione-S-Transferase was observed in the exposed group participants when compared to those of control group participants. The activities of catalase and glutathione peroxidase were found to be significantly increased in experimental group when compared with control group participants [14] reported that erythrocyte SOD and catalase activities in Battery manufacturing workers of Western Maharashtra who were chronically exposed to organic solvents. The activity of GST and GPx was found to be low in the subjects who were exposed to mineral wool was reported [15].

Table 4: Mean Levels of Serum Enzymic Antioxidants in Painters

S.No	Parameters (U/mg protein)	Control group n=40	Experimental group n=40	't' value
1.	Superoxide Dismutase	0.825 ± 0.24	0.666 ± 0.30	2.6207*
2.	Catalase	0.145 ±0.094	0.182 ± 0.057	2.1460 *
3.	Glutathione peroxidase	65.50 ± 16.95	309.3 ± 54.76	26.890 *
4.	Glutathione-S Transferase	0.011 ±0.014	0.005 ± 0.001	2.7092 *

* Significant at 5% level

SOD : (U/mg protein): amount of SOD that causes 50% reduction in the extent of NBT oxidation.
CAT : (U/mg protein): amount of enzyme that brings about a decrease in absorbance of 0.05 at 240nm.
GPx : (U/mg protein): moles of NADH oxidized / mg protein / mg sample.
GST : (U/mg protein): moles of CDNB conjugated / minute/ mg of sample.

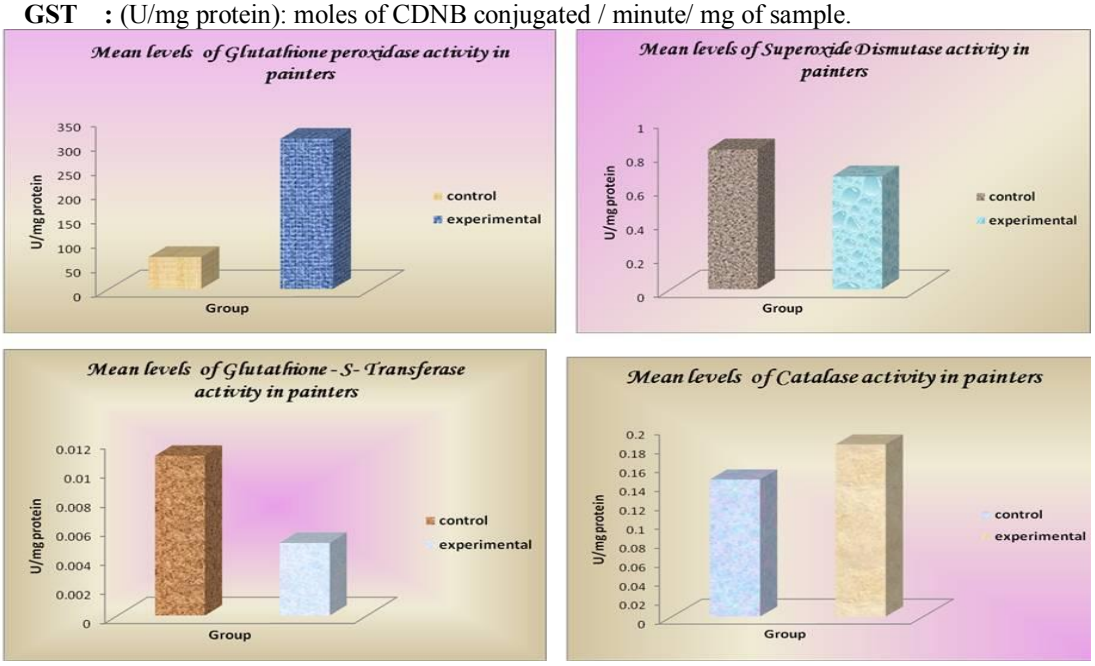

Fig 3: Enzymic Antioxidants Activities in Painters

DNA Damage

The percentage of cells with damaged DNA in the blood from the study and control subjects are summarized in Table-5. A significant increase in the number of cells with comets indicates the DNA damage in experimental group participants when compared to the control participants. The painters are frequently exposed to lead based paints and various organic solvents which lead to DNA damage. Lead exposed workers had significantly elevated levels of DNA breaks when compared with the unexposed group [16]. The increased levels of DNA damage observed in the study group in comparison with the controls justifies the use of comet assay in the evaluation of genotoxicity effects in humans occupationally exposed to different environmental toxicants.

Table 5: DNA Damage in Painters

Mean number of cells with comet per 100 cells			
S.No	Control (n=5)	Experimental group (n=5)	't' value
1	4.6 ± 1.36	31.4 ± 4.27	13.520*

*Significant at 5% level

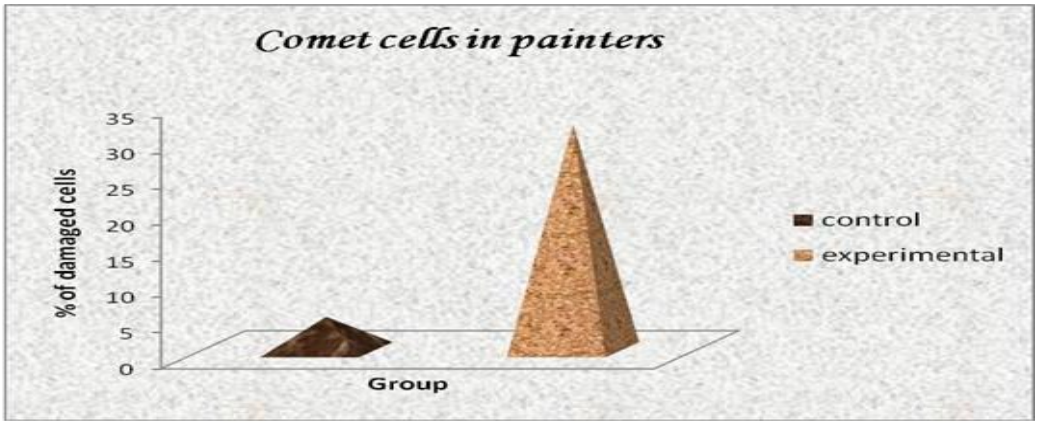

Fig 4: comet cell in painters

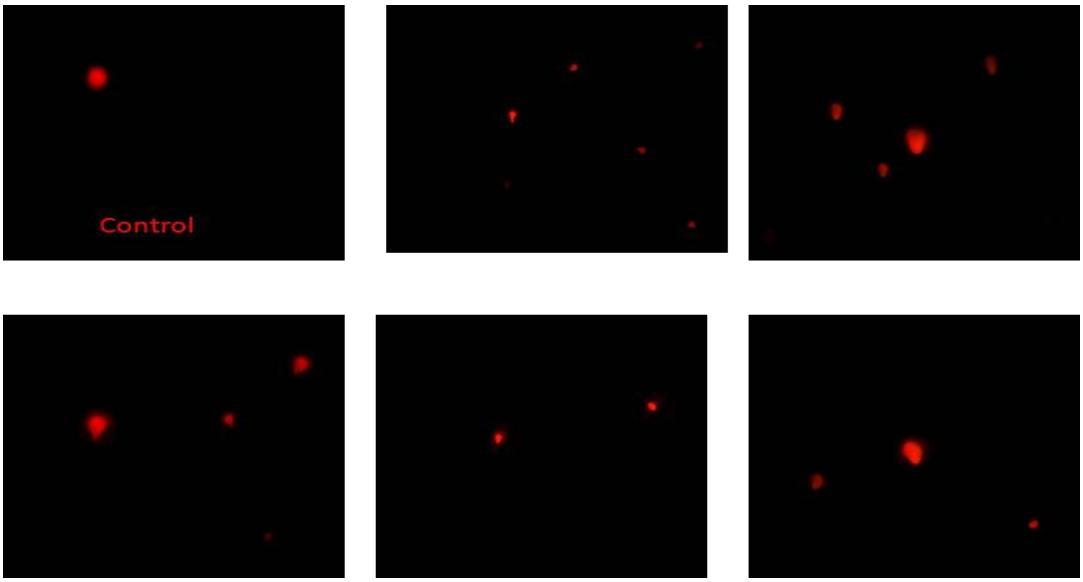

Fig 4.1: Evaluation of DNA Damage Using Comet Assay

CONCLUSION:

In conclusion, the present study demonstrated changes in hematological and biochemical parameters in construction painters. The data obtained also suggested increased level of oxidative stress and DNA damage in the study population. The cytogenetic damage in painters might be associated with their blood lead levels. It is also recommended that, painters must be under continuous free medical follow up through standard timetabled medical laboratory investigations to allow for early detection of any serum biochemical or blood hematological changes that might happen during their long term work and to allow for early treatment whenever necessary.

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