Effects of welding fume particles on heamatological parameters in male Albino rats

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Abstract

Background and objective: Exposure evidence to welding fume aerosols demonstrates that particulate air pollutants can cause both pulmonary and airway inflammation. However, few data show that particulates pollutants can induce systemic inflammatory responses in animals. The aim of this study was to test whether exposure to welding fume by inhalation of its fine and ultra fine particles and different compositions of the electrical welding processes would produce physiological disorders for the blood parameters of exposed rat's animal.

Methods: We conducted the study using hematology coulter counter to analyze whole blood samples of rats after exposure to welding fumes. We investigated the effect of wielding fume exposure on some hematological parameters such as the red blood corpuscles (RBCs), white blood cells (WBCs) and platelet parameters. Fourteen male albino rats were randomly assigned to control or wielding fume inhalation.

Results: Significant decrease were observed after four weeks of wielding fume inhalation in the hemoglobin (Hb) concentration, RBCs count, hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), red distribution width (RDW), mean corpuscular hemoglobin concentration (MCHC), Platelete counts (PLTs) and platelete large cell ratio (P-LCR).On the other hand, platelet distribution width (PDW).

Conclusion: We conclude that inhalation of wielding fume for a long time influence the progression of anemia and inflammation suggesting that welding fume profoundly affects whole-blood profiles.

Keywords: welding fume, blood cellular parameters.

Introduction

The process of welding involves joining metal parts by heating the pieces to melting temperatures [1]. Welding generates high levels of metal fume, which is comprised primarily of fine and ultra fine particles [2]. Epidemiological studies have shown that exposure to welding fumes is associated with metal fume fever [3]. Welders are exposed to a wide range of metals and non-metals with varying and sometimes additive toxic effects. In addition, welders are commonly exposed to physical hazards including heat, electrical current, noise, vibration and light (visible, infrared, ultraviolet) [4]. It has been proposed that inhaled particulates from air pollution may cause systemic alterations by the release of (inflammatory cytokines) subsequent to pulmonary inflammation, which plays an important role in the pathogenesis of atherosclerosis and coronary diseases. Indeed, elevated ambient particulate levels have been shown to be associated with increased levels of inflammatory markers, such as white blood cell counts (WBCs) [5]. In the experimental setting, animal studies have revealed that concentrated ambient particulate exposures increase the total white blood cell counts (WBCs) and the differential count of circulating neutrophils [6,7]. In vitro, ozone degraded arachidonic acid induced an increase in human

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peripheral blood polymorphonuclear leukocyte polarization, decreased human peripheral blood T-lymphocyte proliferation in response to mitogens, and decreased human peripheral blood natural killer cell lysis of K562 target cells. The aldehydic substances, but not hydrogen peroxide, appeared to be the principal active agents responsible for the observed effects. Madden[8] mentioned that ozone-degraded arachidonic acid may play a role in the polymorphonuclear leukocyte influx into lungs and in decreased T-lymphocyte mitogenesis and natural killer cell activity observed in humans and rodents exposed to ozone. Eosinophilia identifies an increase in the eosinophil count. This count has been found to increase with parasitic infections such as toxoplasmosis and with infections by gastrointestinal parasites. Elevations have also been noted with bronchoallergic reactions such as asthma, allergic rhinitis, and hay fever. Eosinophilia has also been noted with skin rashes [9]. Decreases in circulating red blood cell count (RBCs), hemoglobin (Hb) concentration, and hematocrit (HCT) have been correlated with particulate exposure in humans[10]. Savage et al.,[11] found decreased (RBCs) and platelet counts (PLT), hemoglobin concentration (Hb), and hematocrit (HCT) after concentrated ambient particles exposure, as the mechanism of these changes are not presently known. In rats there was a dose-dependent reduction in haemoglobin (Hb) concentration, red cell count (RBCs), and haematocrit (HCT) after Oral exposure to metal phosphides[12]. Subchronic inhalation toxicity of soluble hexavalent chromium trioxide in rats showed the reduction of the number of red blood cell (RBCs) and hematocrit (HCT) values in the 1.25-mg/m3 exposure group. In addition, the hemoglobin values in the 0.50- and 1.25-mg/m3 exposure groups were significantly decreased compared with those of the control group.

Methods

Fourteen male albino rats were 8,10 weeks of age were randomly allocated to either wielding fume exposure for 4 weeks or control group. The animals of the control group were housed in a well ventilated 12 hrs light and dark cycle, while, the rats of the second group housed in the wielding fume sites. Both groups were fed tap water ad libitum, and all rats had constant access to laboratory rat chow. Blood was obtained from rats by cardiac puncture under anesthesia with ketamine hydrochloride(50mg/ Kg) body weight. Blood was immediately determined by using automated hematology analyzer (Coulter counter, Sysmex model:K-1000,Japan) for determining CBC parameters.

Statistical Analysis

All data are expressed as means ± standard error of means (M±SEM) and statistical analysis was carried-out using statistically available software (SPSS version 11.5). Comparisons between groups were made paired student t-test . P values <0.05 were considered significant.

Results

The effect of exposure to welding fume on total red blood cells count (RBCs) and red blood cells indices where observed from the data in Table 1 and Figures 1,2,3,4,5,6 and 7, that show significant decrease at the levels of ($P< 0.05$) for each of these parameters, hemoglobin concentration (Hb) , packed cell volume (PCV) or the hematocrit (HCT) , mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) in experimental animals compared with the controls. Data from Table 2 and Figures 8,9,10 and11, show the effects of welding fume on platelets count and its indices. The significant decreases in (PLTs) counts and (P-LCR) platelets large cell ratio where observed at the levels ($P< 0.05$) in treated rats compared with controls. Whereas (MPV) mean platelets volume and (PDW) platelets distribution width lowered at the levels ($P< 0.05$) in treated rats compared with the controls. Table 3 and figures 12 and 13, exhibit the results which obtained

from the data of the effects of welding fume on total white blood cells count (WBCs) and differential leukocyte count(DLC) of polymorph-onuclear leukocyte (Neutrophils cell percent) of the treated rats compared with the controls. The total white blood cells count (WBCs) and neutrophils percents where significantly increased at the levels (P< 0.05) compared with the con-

Table 1: Effect of wielding fume on RBC count, Hb concentration, Hematocrit, MCV, MCH, RDW and MCHC in male albino rats

	Control	Treatment	t-test
RBC count	6.68±0.447	6.81375±0.272	0.695
Hb count	15.383±0.727	14.125±0.248*	4.596*
Hematocrit	46.383±2.29	44.125±0.618*	2.694*
MCV	69.58±3.567	64.85±2.545*	2.908*
MCH	23.05±1.398	20.75±0.941*	3.691*
RDW	16.32±0.936	13.637±0.517*	6.724*
MCHC	33.183±0.452	32.025±0.383*	5.172*

Each value is the mean ± SE. n-7

- Significant difference between groups P<0.05

Table 2: Effect of wielding fume on platelet count, MPV and P-LCR in male albino rats

	Control	Treatment	t-test
Platelet count	396.833±37.947	381.833±29	0.314
PDW	8.116±0.364	8.412±0.154	2.074*
MPV	7±0.209	7.05±0.104	0.585
P-LCR	7.033±1.134	6.988±0.682	0.095

Each value is the mean ± SE. n-7

- Significant difference between groups P<0.05

Table 3: Effect of wielding fume on WBC count and lymphocyte count in male albino rats

	Control	Treatment	t-test
WBC count	9.62±2.253	14.314±3.362	2.701*
neutrophil	7.14±1.846	10.514±3.752	1.839*

Each value is the mean ± SE. n-7

* Significant difference between groups P<0.05

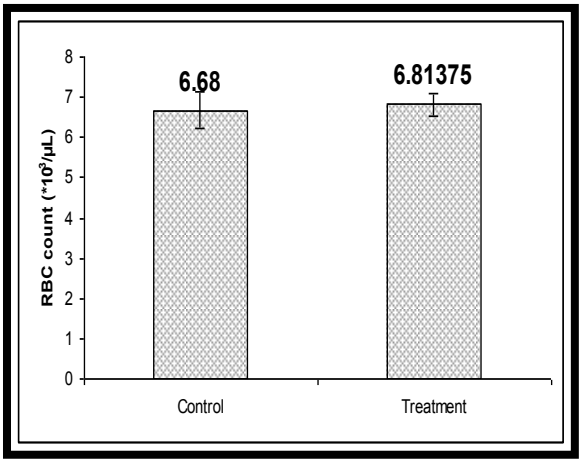

Figure 1: Effect of wielding fume on RBC count in male albino rats

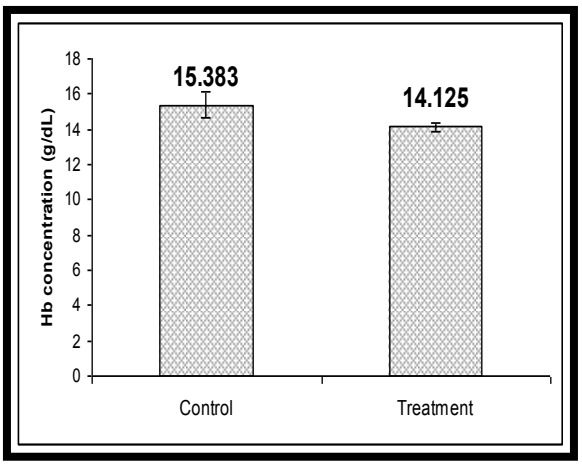

Figure 2: Effect of wielding fume on Hb concentration in male albino rats

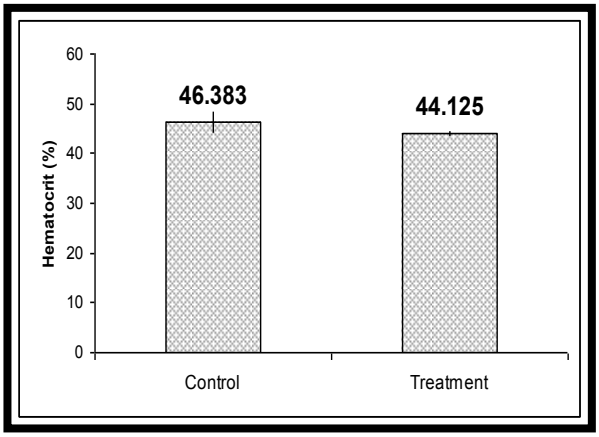

Figure 3: Effect of wielding fume on HCT in male albino rats

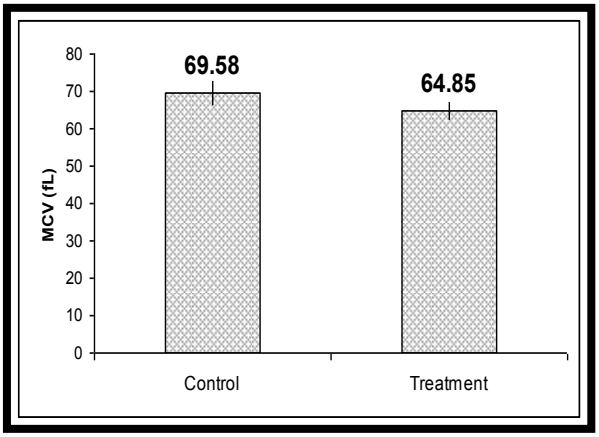

Figure 4: Effect of wielding fume on MCV in male albino rats

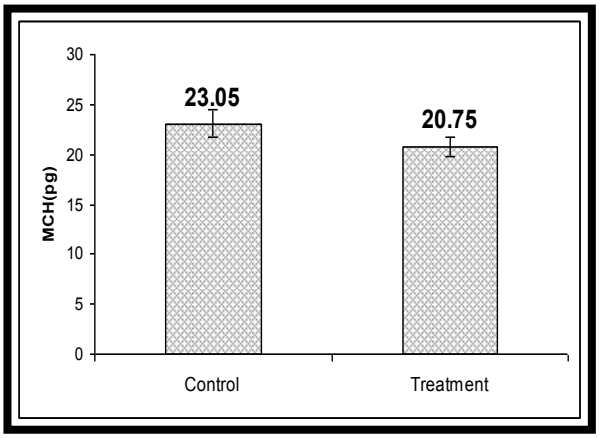

Figure 5: Effect of wielding fume on MCH in male albino rats

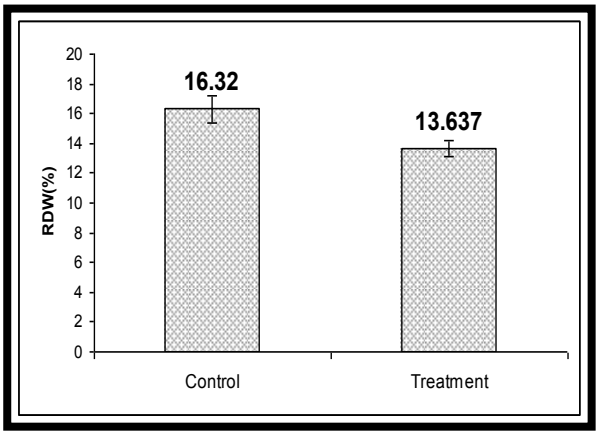

Figure 6: Effect of wielding fume on RDW in male albino rats

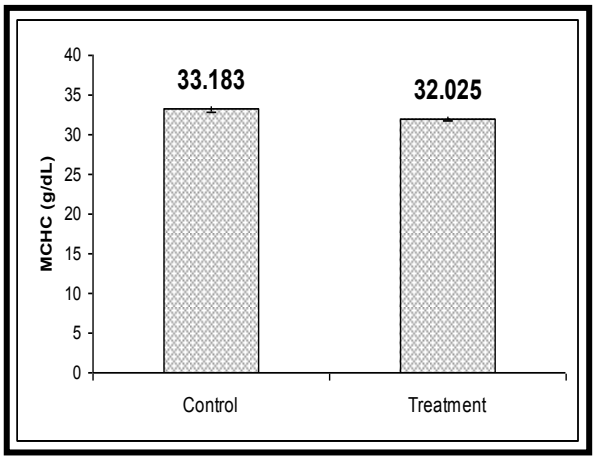

Figure 7: Effect of wielding fume on MCHC in male albino rats

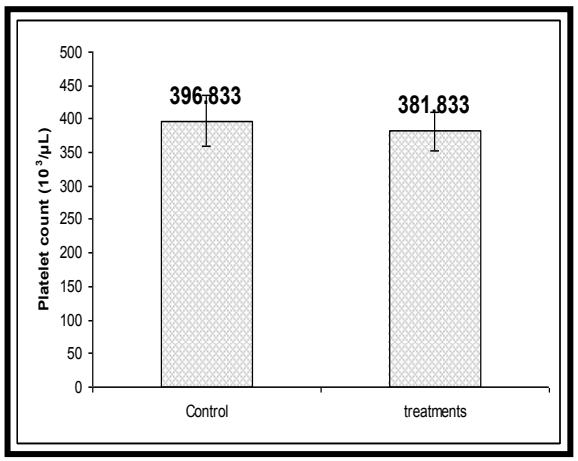

Figure 8: Effect of wielding fume on platelet count in male albino rats

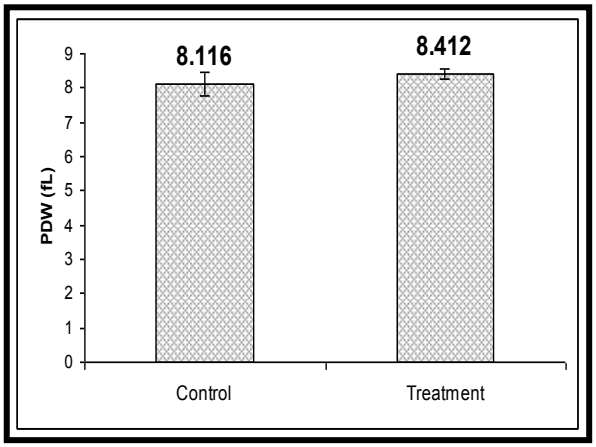

Figure 9: Effect of wielding fume on PDW in male albino rats

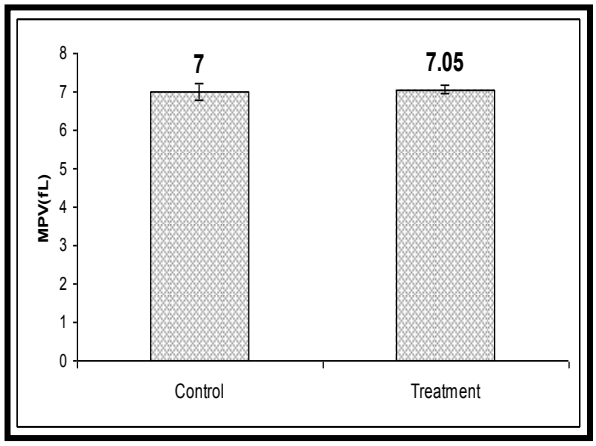

Figure 10: Effect of wielding fume on MPV in male albino rats

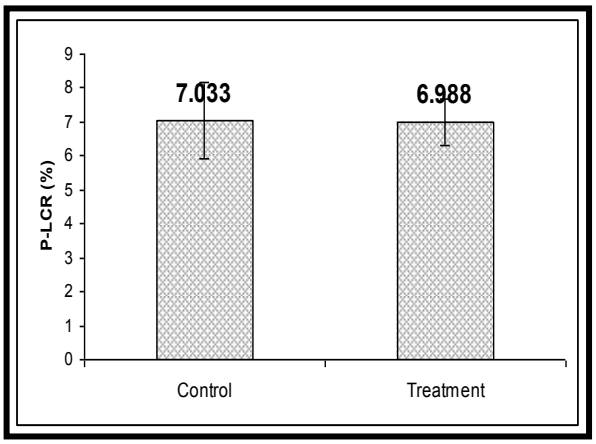

Figure 11: Effect of wielding fume on P-LCR in male albino rats

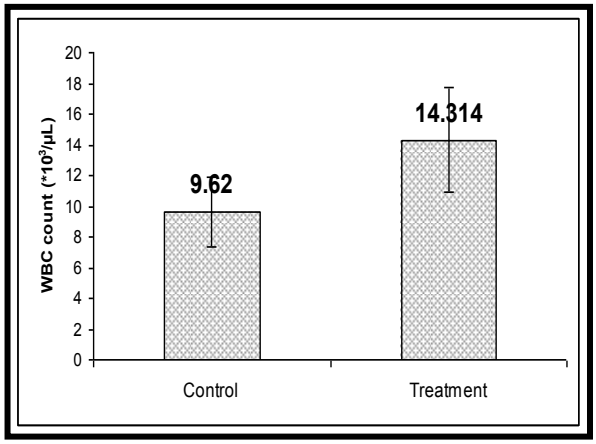

Figure 12: Effect of wielding fume on WBC count in male albino rats

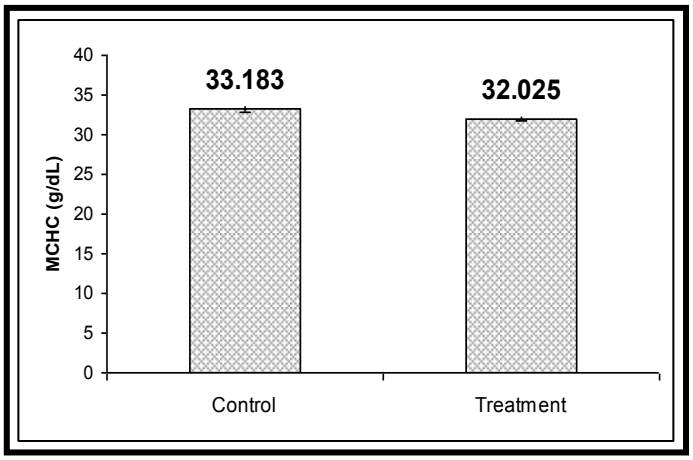

Figure 13: Effect of wielding fume on lymphocyte count in male albino rats

Discussion

Seaton et al.[10] observed a decrease in circulating red blood cells count (RBCs), hemoglobin concentration (Hb), and hematocrit (HCT) have been correlated with particulate exposure in humans. Bai et al.[12]. Subchronic inhalation toxicity of soluble hexavalent chromium trioxide in rats showed the reduction of the number of red blood cells count (RBCs) and hematocrit (HCT) values. Tumor necrosis factor alpha (TNF-α) was a key mediator, playing a large role in the initial response of metal fume fever [13]. Recently some authors mention that tumor necrosis factor alpha (TNF-α) have an inhibitory effect on erythropoiesis [14,15]. Even we did not account for any clinical condition that may have affected the complete blood count (CBC) results, as no such information was available, but our results were in agreement with the finding of Savage et al.,[11] mentioning decreased (RBCs) and platelet counts (PLTs), hemoglobin concentration (Hb), and hematocrit (HCT) after concentrated ambient particles exposure. The mechanism of these changes are not presently known. Unfortunately there were no available satisfy data from the literature concluded clinical condition of the effects of welding fume in the platelet count and platelet indices, but our study is in agreement with a researcher[11] who mentioned the decreased platelet count (PLTs) after concentrated ambient particles exposure. The mechanisms of these changes are not presently known. We assume that animal who exposure to welding fume over those who do not exposed to ambient particles have certain response for the platelets count. Schwartz[5] proposed that inhaled particulates from air pollution may cause systemic alterations by the release of inflammatory cytokines subsequent to pulmonary inflammation. Trichloroethylene (TCE) is one of the agents commonly used in welding process, and has a high vapor pressure in welding fume16. Mild macrocytic anemia has been observed in some workers occupationaly exposed to trichloroethylene [17,18]. Blanc et al.[13] hypothesized that tumor necrosis factor alpha (TNF-α) was a key mediator, playing a large role in the initial response of metal fume fever, whereas IL-6 and IL-8 are likely involved in the later response. Welding fume is comprised of various gases and metal containing fine and ultrafine particles, with 90% of the particles having an aerodynamic mass median diameter less than 1 μm,[1,2]. Schwartz[5] observed a significant positive relation between circulating (WBCs) specially and the differential leukocyte count (DLC) of circulating neutrophils and particulate matter with an aerodynamic mass median diameter ≤10 μm (PM10), after controlling for several variables including smoking.

Conclusion

Indeed, elevated ambient particulate levels have been shown to be associated with increased levels of inflammatory markers, such as total WBCs, platelets indices, RBCs indices, and whole blood profiles.

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