Original Research Article

HAEMATOLOGICAL EFFECT OF TOLUENE IN WISTAR RATS

Abstract

Toxicity of toluene arising from solvent abuse, occupation hazards and environmental pollution has generated a lot of concern in recent times. Young people are getting more involved in the abuse of toluene by deliberate inhalation of toluene-containing substances which may result in high level of exposure to toluene. This abuse may have adverse effect on their health. This study was therefore designed to investigate the effect of oral exposure to toluene on haematological parameters using male albino rats as model. Twenty animals were randomly divided into 4 groups of 5 rats each. Group A (Control) received 0.5 ml of olive oil (vehicle) while groups B, C and D received 31.8, 63.6 and 127.2 mg/kg respectively of toluene for 21 days by oral gavage. At the end of the treatments, the animals were anaesthetized and blood samples were collected for haematological investigations. No significant ($p > 0.05$) variation occurred in the mean values of PCV, haemoglobin concentration, RBC and platelet counts in comparison with the control. There was a significant ($p < 0.05$) increase in WBC count with no significant ($p > 0.05$) change in the differential leucocyte counts relative to the control. Oral administration of toluene as used in this study may be toxic to health depending on the dose and duration of exposure.

Keywords: toluene, blood, toxicity, solvent abuse

Introduction

In recent times, toluene has emerged as the most commonly abused solvent [1,2] and which, with increased dose and duration of exposure, can lead to toxicity. Toluene is an organic hydrocarbon used in the manufacturing of dyes, nail, shoe polish, inks and paint thinners. It is widely used in cosmetic industry and is also a component of nylon and plastic bottles [2]. Toxicity of toluene can occur from accidental or deliberate inhalation of fumes, ingestion or transdermal absorption, toluene abuse or "glue sniffing" which has become rampant, especially among young people, since it is readily available and affordable [2]. Among children and adolescents, toluene is frequently abused by dousing cloth with paint, inks and the like, and placing it over the nose and mouth for inhalation in a bid to get intoxicated and a sensation of euphoria. Toluene, when inhaled, is known to be readily absorbed into the bloodstream.

Blood, as integral component of the body system, is used to detect any disorder or anomaly arising from exposure to all forms of injuries that can adversely affect health. Haematological study is important in assessing the toxicity of drugs and pollutants in the body since blood is the major transport system of the body [3]. According to Oke *et al.* [4], anything that affects the blood will to a great extent affect the entire

body either adversely or moderately in terms of health, growth, maintenance and reproduction. It is against this background therefore that this study was designed to investigate the effect of toluene toxicity on blood parameters using male albino rats as model. This study has become necessary considering the increasing rate at which young people engage in the abuse of organic solvents in order to get to a point of ecstasy.

Material and Methods

Chemicals and Reagents

Toluene, with CAS No: 108-88-3, was purchased from Bernaco Enterprises Nigeria as clear colourless liquid with pleasant aromatic petroleum odour. The desired doses were prepared in Goya® olive oil which was purchased from the supermarket.

Animals and Treatment

Twenty (20) mature male albino rats weighing an average of 200g, purchased from the Animal House of Department of Pharmacology, College of Health Sciences, University of Port Harcourt were used for this study. The rats were acclimatized for two (2) weeks before the study was commenced. They were fed *ad libitum* with commercially sourced feed (Top Feeds Nigeria Limited) and supplied with clean drinking water all through the study. After acclimatization, the animals were randomly assigned to four (4) groups – A, B, C and D. Group A served as the control and was given 0.5ml of olive oil (vehicle) while the treatment groups B, C and D received 31.8 mg/kg, 63.6mg/kg and 127.2 mg/kg, respectively of toluene which corresponded to 1/20, 1/10 and 1/5 of the LD50 which is 636mg/kg according to Doro-on [5]. Treatments were by oral gavage daily for 21 days. At the end of the treatments, the animals were anaesthetized and blood samples were collected by cardiac puncture into EDTA bottles. The collected blood samples were used for the estimation of haematological parameters such as packed cell volume (PCV), haemoglobin concentration (HB), red blood cell count (RBC), white blood cell count (WBC), platelets count, lymphocyte and neutrophil levels according to Cheesebrough [6].

Statistical Analysis

Statistical analysis was done using SPSS 21. All values were expressed as mean ± SEM and data were assessed by one-way ANOVA followed by the Tukey post-test. The significance level was set at $p<0.05$.

Results

The effect of different doses of toluene on various haematological parameters are summarized in figures 1 - 5 and Table 1. Treatment of rats for 21days with 31.8, 63.6 and 127.2 mg/kg doses of toluene had no significant ($p>0.05$) effect on PCV, haemoglobin concentration, RBC and platelet counts relative to the control as shown in figures 1 - 4.

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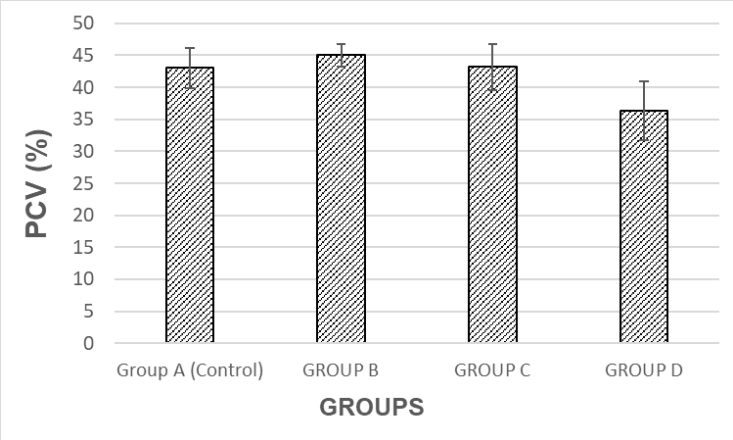

Fig. 1. Effect of Toluene on Packed cell volume (PCV) of rats treated for 21 days. Results are given as mean ± SEM for 5 rats in each group. Experimental groups are compared with group A (control). No significant difference at a 95% confidence interval ($p >0.05$). Groups A, B, C and D represent the control (given 0.5 ml olive oil), 31.8 mg/kg treated rats, 63.6mg/kg treated rats and 127.2 mg/kg treated rats, respectively.

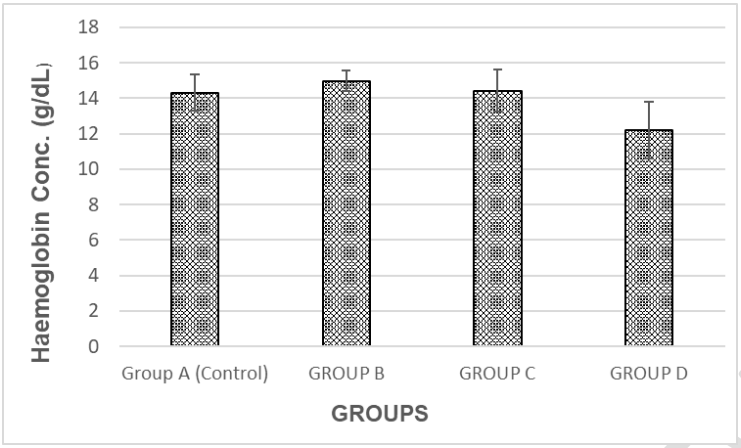

Fig. 2. Effect of Toluene on Haemoglobin Concentration of rats treated for 21 days. Results are given as mean ± SEM for 5 rats in each group. Experimental groups are compared with group A (control). No significant difference at a 95% confidence interval ($p > 0.05$). Groups A, B, C and D represent the control (given 0.5 ml olive oil), 31.8 mg/kg treated rats, 63.6mg/kg treated rats and 127.2 mg/kg treated rats, respectively.

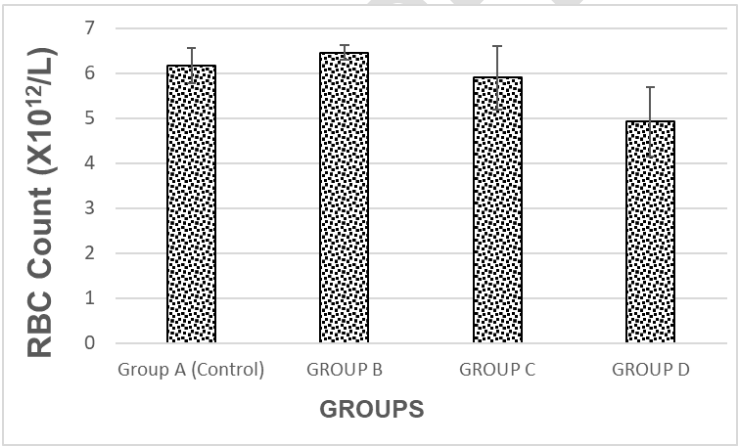

Fig. 3. Effect of Toluene on Red Blood Cell (RBC) Count of rats treated for 21 days. Results are given as mean ± SEM for 5 rats in each group. Experimental groups are compared with group A (control). No significant difference at a 95% confidence interval ($p > 0.05$). Groups A, B, C and D represent the control

(given 0.5 ml olive oil), 31.8 mg/kg treated rats, 63.6mg/kg treated rats and 127.2 mg/kg treated rats, respectively.

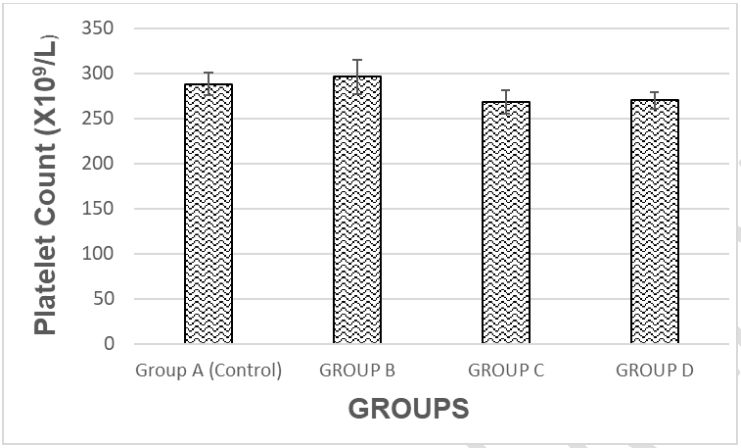

Fig. 4. Effect of Toluene on Platelet Count of rats treated for 21 days. Results are given as mean ± SEM for 5 rats in each group. Experimental groups are compared with group A (control). No significant difference at a 95% confidence interval ($p > 0.05$). Groups A, B, C and D represent the control (given 0.5 ml olive oil), 31.8 mg/kg treated rats, 63.6mg/kg treated rats and 127.2 mg/kg treated rats, respectively.

Figure 5 shows that treatment of rats for 21days with 31.8 and 63.6 mg/kg doses of toluene produced no significant ($p>0.05$) change on the WBC count in relation to the control. However, only toluene treated group D (127.2 mg/kg) showed significant increase ($p<0.05$) in the WBC count in comparison with the control.

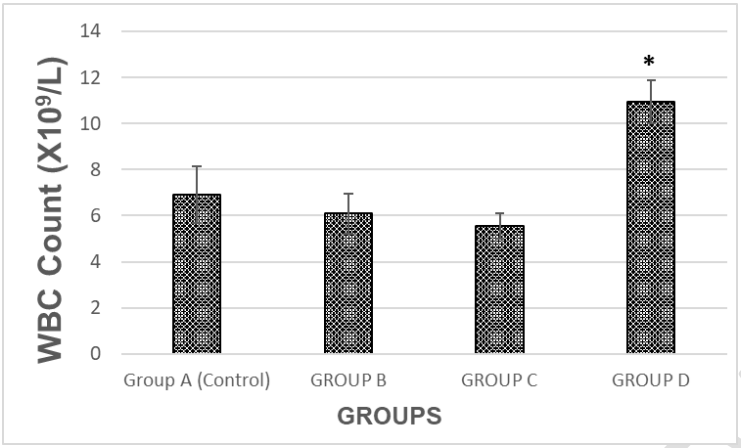

Fig. 5. Effect of Toluene on White Blood Cell (WBC) count of rats treated for 21 days. Results are given as mean ± SEM for 5 rats in each group. Experimental groups are compared with group A (control). * indicates a significant difference at $p < 0.05$. Groups A, B, C and D represent the control (given 0.5 ml olive oil), 31.8 mg/kg treated rats, 63.6mg/kg treated rats and 127.2 mg/kg treated rats, respectively.

The differential leucocyte count which involves the neutrophil, eosinophil, lymphocyte and monocyte counts did not change markedly ($p>0.05$) with toluene treatment (Table 1).

Table 1: Effect of Toluene on Differential Leucocyte Count of rats exposed for 21 days

PARAMETERS / GROUPS	Neutrophils (%)	Lymphocytes (%)	Eosinophils (%)	Monocytes (%)
A	30.60 ± 2.79	67.40 ± 2.79	0.60 ± 0.40	1.40 ± 0.60
B	36.6 ± 3.33	62.60 ± 3.50	0.00 ± 0.00	0.80 ± 0.49
C	26.40 ± 1.36	70.40 ± 1.63	1.20 ± 0.37	2.00 ± 0.55
D	34.60 ± 1.72	63.60 ± 1.57	0.40 ± 0.40	1.40 ± 0.87

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Results are given as mean ± SEM for 5 rats in each group. Experimental groups are compared with group A (control). No significant difference at a 95% confidence interval ($p > 0.05$). Groups A, B, C and D represent the control (given 0.5 ml olive oil), 31.8 mg/kg treated rats, 63.6mg/kg treated rats and 127.2 mg/kg treated rats, respectively.

Discussion

Haematological parameters are health markers which aids diagnoses and the evaluation of physiological and pathological status of animals. According to Olafedehan *et al.* [7], blood acts as a pathological reflector of the status of exposed animals to toxicant and other conditions. From this study, oral ingestion of toluene by albino rats produced no significant effect on their PCV, RBC count, haemoglobin concentration and platelet count. Although there was a significant increase in the WBC count at the highest dose of 127.2mg/kg, the differential leucocyte count was not affected. This increase in mean WBC count could be attributed to the presence of toluene in the body.

Higher WBC count is usually associated with prevalence of stress, inflammation, infection, allergy or certain diseases [8]. Similarly, animals with high WBC counts produce antibodies during the process of combating the causative agents through phagocytosis [9]. The elevated WBC count triggered by the presence of causative agent ranging from biological, physical, chemical or thermal agents, in turn, leads to immunity to diseases, infection or allergy as a result of the generated antibodies in the body. This finding is in line with the work done by Ita and Udofia [10], who reported that the increase in WBC count of rats that orally ingested gasoline for 21 days could be a defensive mechanism developed by the body against toxicity of the gasoline constituents, which include toluene.

The non-significant change recorded in the differential leucocyte count suggests that the immune responses of the body to infection may not have been compromised. [11]. This finding is similar to that of Obinna *et al.* [12] who reported that rats treated with polar leaf extracts of *Portulaca oleracea* for 60 days, showed a significant increase in the WBC count, with a non-significant variation in the differential leucocytes count.

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Conclusion

The present study, which provided insight into the toxicity of subacute exposure to toluene, concludes that oral administration of toluene as used in this study may be toxic to blood in particular and the entire body

system in general, depending on the dose and duration of exposure. Further study on the effect of toluene in experimental animal for a longer duration of exposure is recommended.

Competing Interests

Authors have declared that no competing interests exist.

Ethical Approval

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee

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