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Research Article

Estimation of Haematological Parameters among Sudanese Worker Exposed to Pesticides

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Abstract

Background: Exposure to Pesticides may lead to high risk of toxicity, in which these chemical compounds can affect blood component causing chronic diseases and inflammations.

Design: This descriptive case control study was conducted in Khartoum state from November to December 2021.

Objectives: The goal is to measure the effect of pesticides on blood parameters among exposures compared to healthy individuals using the analysis of complete blood count. And to correlate between duration of work according to age and gender.

Materials and Methods: 3 ml of intravenous blood samples were collected from 500 participants, 400 samples from men and 100 samples from women aged between 20-65 years, majority were dealers and the rest of them were working at farms and the structural questionnaire was used.

Results: The results of these study show marked increase in red blood cells and absolute lymphocytes count accompanied by decreased in platelets count, platelets distribution width, mean platelets volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and red cells distribution width upon exposures to pesticides for long time.

Conclusion: This study concluded that there is decrease in PLTs count, PDW, MPV, MCH, MCHC, RDW, and an increase in RBCs count and absolute lymphocytes count among pesticides exposures.

Keywords: Hematology parameters; Sudanese; Pesticides

Introduction

Pesticides are a broad group of heterogeneous chemicals that have a significant public health benefit by increasing food production productivity and decreasing food-borne and vector-borne diseases. However, depending on the agent and the exposure, they may pose health risks. Because of their behaviour, acute accidental toxic exposures occur more commonly in children. Pesticides are substances that are used to prevent, repel, or destroy pestsorganisms that compete for food supply, adversely affect comfort, or endanger human health [1]. Several classes of compounds are used for this purpose. More than 20 000 pesticide products with nearly 900 active ingredients are registered for use

as insecticides, miticides, herbicides, rodenticides, nematocides, fungicides, fumigants, wood preservatives, and plant growth regulators. Pesticides are ubiquitous in the environment. They are found in food, water, homes, schools, workplaces, and gardens. Pesticides have significant economic, environmental, and public health impacts. Pesticide usage helps improve human nutrition through greater availability, which affect millions of children and adults and kill thousands annually in the United States alone [2,3].

Pesticides also pose human health concerns because they are toxic substances and widely released into the environment. Although the toxic actions of pesticides are targeted at specific pest species. The most commonly used classes of pesticides are composed of different types of chemicals with different mechanisms of action, most insecticides work by interfering with nervous system function. Organophosphates. which account for approximately one half of the insecticides used in the United States, and carbamates, which are widely used in homes and gardens, inhibit the activity of acetylcholinesterase at nerve endings, resulting in an excess of the neurotransmitter acetylcholine and a depolarizing blockade of neural transmission. The effects of carbamates are more readily reversible and of shorter duration. Organochlorines, such as dichlorodiphenyltrichloroethane (DDT) and lindane, interfere with nerve cell membrane cation transport, resulting in neural irritability and excitation of the central nervous system, they are used in varying concentrations to reduce the risk of insect stings and vector-borne diseases such as Lyme disease, West Nile disease, and Rocky Mountain spotted fever. Toxic encephalopathy and seizures can result from ingestion or, less common, from dermal absorption [4,5]. Herbicides, including the chlorophenoxy compounds are primarily irritative to the skin and respiratory tract during acute exposures and work by different mechanisms. Some substances, such as paraquat, are highly corrosive and can cause multisystem injury and progressive pulmonary failure [4-6].

Materials and Methods

This is a case control study was conduct in Khartoum state during the period of two months Jun 2021 - December 2021, blood sample was collected from 50 0Sudanese vaccinated by AstraZeneca vaccine and 500 normal controls. 3 ml of venous blood samples were collected by syringes in EDTA container from individuals that exposed to pesticides and healthy people. Each blood sample was analysed by haematology analyserand results was recorded.

Methodology

Principle of Haematology Analyser

Coulter principle is used in almost every hematology analyzer. The coulter principle is based on the detection and measurement of changes in electrical resistance produced by a particle or cell suspended in a conductive liquid (diluent) traversing through a small aperture. When particles or cells are suspended in a conductive liquid, they function as discrete insulators. When a dilute suspension of particles is drawn through a small cylindrical aperture, the passage of each individual cell momentarily modulates the impedance of the electrical path between two submerged electrodes located on each side of the aperture, creating an electrical pulse. Illustrates the passage of a cell through an aperture. The number of electrical pulses indicates cell count, while the amplitude of the electrical pulse produced depends on the cell's volume [7].

Results

This study shows statistically significant difference in RBCs count, MCH, MCHC and RDW among case and control, p value (0.005), (0.000), (0.024), (0.023) respectively. And statistical insignificant in HB. PCV and MCV (Table 1). This present study appears statistically significant difference in lymphocyte among case and control p value (0.000) and statistical insignificant in WBCs count, neutrophil, monocyte, eosinophil, basophil (Table 2). This current study shows statistically significant in PLTs count, PDW, and MPV in study group case and control P value (0.001), (0.002), (0.000) respectively (Table 3).

Table 1: Mean of Red Blood Cell Profile in Pesticides Exposures Compared to Control.

RBCs profile	Mean±SD	Mean±SD	P value
	Case	Control	
RBCs count cell/l	5.36±0.73	5.03±0.34	0.005^{S}
HB g/dl	14.3±2.01	14.5±0.86	0.615^{NS}
PCV %	44.5±5.72	43.9±2.72	0.566^{NS}
MCV fl	84.4±5.32	85.5±2.35	0.213^{NS}
MCH pg	26.86±2.76	28.51±1.17	0.000^{S}
MCHC g/l	32.17±1.75	32.82±1.00	0.024^{S}
RDW-SDfl	15.08±1.83	14.40±0.95	0.023^{S}

Table 2: Mean of WBCs& Differential Count in Profile in Pesticides Exposures Compared to Control.

WBCs& Differential Count	Mean±SD Case	Mean±SD Control	P value
TWBCs cell/l	6338±1640	5868±1144	0.100^{NS}
Lymphocyte cell/l	2628±0.830	2068±0.470	0.000^{S}
Neutrophil cell/l	3358±1142	3538±1110	0.426^{NS}
Monocyte cell/l	0.282±0.163	0.262±0.133	0.516^{NS}
Eosinophil cell/l	0.203±0.810	0.082±0.086	0.297^{NS}
Basophil cell/l	00.0±00.0	00.0±00.0	-

Table 3: Mean of PLTs profile in Pesticides Exposures Compared to Control.

PLTS Profile	Mean±SD Case	Mean±SD Control	P value
PLTs cell/l	209.2±75.2	252.2±39.5	0.001^{S}
PDW fl	15.5±2.7	14.1±1.7	0.002^{S}
MPV fl	11.6±1.01	9.9±1.25	0.000^{S}

This study shows statistically significant in pesticides exposures according to gender in RBCs count, HB and PCV p value (0.001), (0.000), (0.000) respectively, and statistical insignificant in MCV, MCH, MCHC and RDW (Table 4). This present study shows statistical insignificant difference in pesticides exposures according to gender in TWBCs, lymphocyte, neutrophil, monocyte, eosinophil, and basophil (Table 5).

Table 4: Mean of Red Blood Cell Profile in Pesticides Exposures According to Gender.

RBCs Profile	Mean±SD Male	Mean±SD Female	P value
RBCs Count cell/l	5.32±0.610	4.89±0.420	0.001^{S}
HB g/dl	14.8±1.28	13.3±1.60	0.000^{S}
PCV %	45.2±4.12	41.8±4.37	0.000^{S}
MCV fl	85.2±3.14	84.3±5.89	0.284^{NS}
MCH pg	27.81±1.93	27.37±2.95	0.459^{NS}
MCHC g/l	32.7±1.01	31.9±2.11	0.054^{NS}
RDW-SDfl	14.6±1.01	15.1±2.25	0.144^{NS}

Table 5: Mean of WBCs& Differential Count in Profile in Pesticides Exposures According to Gender.

WBCs& differential count	Mean±SD Male	Mean±SD Female	P value
TWBCs cell/l	6023±1499	6300±1232	0.380^{NS}
Lymphocyte cell/l	2317±0.736	2424±0.715	0.507^{NS}
Neutrophil cell/l	3417±1.128	3524±1131	0.667^{NS}
Monocyte cell/l	0.278±0.138	0.256±0.173	0.502^{NS}
Eosinophil cell/l	0.167±0.862	0.083±0.064	0.508^{NS}
Basophil cell/l	00.0±00.0	00.0±00.0	-

This present study appears statistically significant difference in pesticides exposure according to gender in PLTs count p value (0.007) and statistical insignificant in PDW and MPV (Table 6). This current study shows statistical insignificant difference in pesticides exposure according to duration and age in RBCs count, HB, PCV, MCV, MCH, MCHC and RDW (Table 7). This present study appears statistical insignificant difference in pesticides exposure according to duration and age in TWBCs, lymphocyte, neutrophil, monocyte eosinophil, and basophile (Table 8 & Figure 1). This current study shows statistical insignificant difference in pesticides exposure according to duration and age in PLTs, PDW and MPV (Table 9 & Figure 2).

Table 6: Mean of PLTs Profile in Pesticides Exposures According to Gender.

PLTS profile	Mean±SD	Mean±SD	P value
	Male	Female	
PLTs cell/l	219.9±64.4	257.3±53.5	0.007^{S}
PDW fl	14.8±2.48	14.6±2.04	0.797^{NS}
MPV fl	10.9±1.31	10.5±1.58	0.158^{NS}

Table 7: Correlation of Red Blood Cell Profile with Duration of Exposure and Age.

RBCs profile	Duration	P value	Age	P value
	R/Pearson		R/Pearson	
RBCs count cell/l	0.152	0.131^{NS}	-0.049	0.627^{NS}
HB g/dl	0.007	0.943^{NS}	-0.036	0.724^{NS}
PCV %	0.099	0.325^{NS}	-0.016	0.873^{NS}
MCV fl	0.073	0.468^{NS}	-0.02	0.846^{NS}
MCH pg	-0.141	0.162^{NS}	-0.082	0.417^{NS}
MCHC g/l	-0.177	0.078^{NS}	-0.167	0.097^{NS}
RDW-SDfl	0.113	0.263^{NS}	-0.031	0.760^{NS}

Table 8: Correlation of WBCs& Differential Count with Duration of Exposure and Age.

RBCs profile	Duration	P value	Age	P value
	R/Pearson		R/Pearson	
TWBCs cell/l	-0.164	0.102^{NS}	0.01	0.919^{NS}
Lymphocyte cell/l	0.082	0.417^{NS}	-0.034	0.737^{NS}
Neutrophil cell/l	-0.259	0.009^{S}	0.071	0.480^{NS}
Monocyte cell/l	-0.088	0.382^{NS}	-0.013	0.898^{NS}
Eosinophil cell/l	-0.021	0.837^{NS}	0.023	0.821^{NS}
Basophil cell/l	-	-	-	-

Table 9: Correlation of PLTs Profile with Duration of Exposure and Age.

RBCs profile	Duration	P value	Age	P value
	R/Pearson		R/Pearson	
PLTs cell/l	-0.348	0.000^{S}	0.052	0.606^{NS}
PDW fl	0.041	0.686^{NS}	-0.043	0.669^{NS}
MPV fl	0.081	0.424^{NS}	-0.182	0.070^{NS}

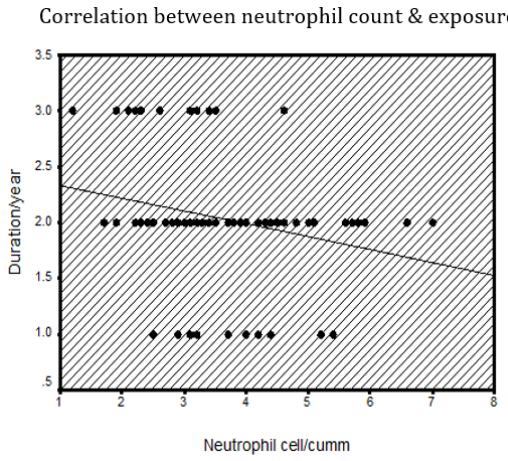

Figure 1: Weak Negative Correlation.

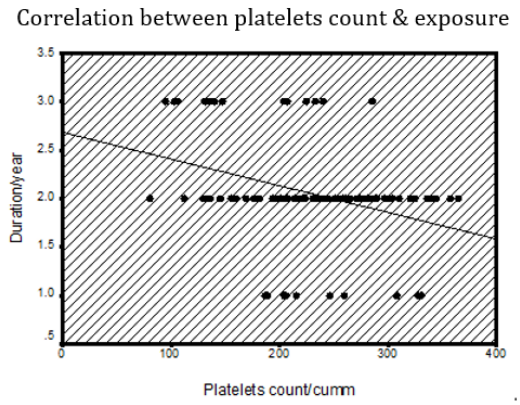

Figure 2: Medium Negative Correlation.

Discussion

Pesticides are substances that are used to prevent, repel, or destroy pestsorganisms that compete for food supply, adversely affect comfort, or endanger human health [1,8]. Our study present clear changes in haematological parameters in pesticides exposures group compared with control group, some parameters were found to have unusual levels such as RBCs profile (RBCs count, MCH, MCHC), absolute lymphocytes count and PLTs profile (PLTs count, MPV, PDW). In similar study done by Atef MK et al. which was conduct in (2016) 8 show agreement with our study in which there is significant decrease in PLTs, MPV and PDW, MCH and MCHC among pesticides workers and sprayers. However, Atef MK et al. reported significant difference in HB, TWBC, and differential leukocytes count which was below the normal compared with control group [9,10]. Another study of Manel Araoud et al. (2012) 9 disagree in the same haematological parameters, there were no significant differences in PLT, RBC and total leukocyte count values between exposed workers and the control group, the MCV and HCT were higher in exposures group compared with control group, whereas MCH and MPV were significantly higher [11-32].

Declarations

Ethical Approval and Consent to Participant

Approval of This study was obtained from hematology department of medical laboratory science (MLS), Elrazi University, and ministry of health issued by the local ethical committee, Khartoum State, Sudan. Written consent was taken from each member of the study.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets generated during and / or analyzed in this study are not publicly available due to Khartoum vaccinate ethical policy to protect participant confidentiality.

Competing Interest

The authors declare that they have no competing interests.

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Authors Contributions

AH and AA, MA, SK, RT, and KG contributed to literature search and manuscript writing. AH had the main idea of the study and contributed to manuscript writing, AA, MA, SK, RT, and KG contributed to clinic work, AH contributed to statistical analysis. AH supervised the study and critically reviewed the manuscript. All authors read and approved the final draft of the manuscript.

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