



Journal of Biological Sciences

ISSN 1727-3048

science
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Haematologic Indices in Pesticide Factory Workers

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Abstract: The purpose of this study was to evaluate the effect of pesticides on blood indices of subjects which are exposed to organophosphate toxins. This research was a cohort study which was carried out during 2005 on the employee of a pesticide factory in Golestan province (North of Iran). In this study the sampling from 63 subjects was carried out for two sessions in days 1 and 90. CBC and hematologic indices performed by cell counter instrument. The mean of MCV in phase 1 was 82.8 ± 7.1 fl and in second phase the MCV was 80.3 ± 6.7 fl. This drop in MCV statistically was meaningful (paired t-test, mean = 2.5, 95% CI=2.0-2.9, $p < 0.001$). Erythrocyte number, hemoglobin, HCT and MCHC increase in second phase compared to first phase statistically was meaningful. There was not any significant relation between the place of work and variation of red blood cell indices. In regard to the changes in hematologic indices in workers of pesticide factory in a three months period, it seems logical to set up a program to have a routine check on the hematologic indices in working personal engaging in such occupations.

Key words: Pesticide, organophosphate, hematologic indices, MCV, hemoglobin, hematocrit

INTRODUCTION

It is estimated that nearly 3 million people are poisoned annually with organophosphate world-wide. Out of this number 300000 people either die or seriously are hurt (Eyer, 2003).

Toxins can damage an organ or organ systems. So that it can not function properly, leading to death or sickness of the organism. Nearly in all cases, the toxin activity exerts its harmful effect directly on specific cells or biochemical within the affected organ. These cells and chemical change in turn cause the tissue or organ to malfunction (Lu, 1996). The body is a remand able complex living machine consisting of trillions of cells and multitudes of biochemical reactions. Each cell has a specific function and they work in harmony to promote the health and vitality of the organism. The number and types of toxic reactions is likely very large (Klaassen, 1996).

In an experimental research the subchronic effect of a new phosphorothionate was studied on Wistar rates, after 90 days hemoglobin (Hb), hematocrit (HCT) and

erythrocyte number (RBC) level showed a meaningful reduction, but on other hand MCV, MCH and MCHC level was increased (Rahman and Siddiqui, 2006). In other study on the effect of sulphur mustard on war victims it was shown that the level of RBC and HCT was increased when it was compared to the control group (Balali-Mood *et al.*, 2005). These hematological changes may be due to systematic toxification effect of toxins. Erythrocyte indices are helpful for monitoring erythrocyte synthesis status and liver condition. The half life of red blood cells is about eight weeks (Irwin and Kirchner, 2001). Therefore, due to this reason in this study the changes in blood indices of pesticide factory workers were determined after 12 weeks.

The purpose of this study was to evaluate the effect of pesticides on blood indices of subjects which are exposed to organophosphate toxins.

MATERIALS AND METHODS

Present research was a cohort study and carried out during 2005 on the pesticide factory workers in Golestan

province (North of Iran, south-east of Caspian Sea). A questionnaire was filled for every employee and 5 mL of blood was taken from each participant. Serum was separated using centrifugation and stored at -70°C until performance of the test. Two milliter of blood containing EDTA immediately transferred to hematology laboratory for CBC test. During two phases of the study that lasted for 3 months, 63 working personnel of the factory went under this investigation.

CBC performed by cell counter (Abacus). Albumin, AST and ALT measurements were carried out by Bromocresol Green (BCG) technique and by IFCC (international federation of clinical chemistry) using Pars azmoon company kit (Iran) by photometer (clinic II), respectively. The confidence interval for all the tests considered to be 95%.

RESULTS

In this study, 63 male were gone under investigation. The minimum and maximum age of the employees was 21 and 53 years, respectively (32.0±8.0).

The mean value of RBC, Hb, MCV, MCH, MCHC, AST, ALT and serum albumin are presented in Table 1.

On the basis of employee place of work, the subjects were divided into two groups, as follow: 29 persons (46%) in the production sections and 34 persons (54%) in other sections of the factory. There was not any significant relation between the place of work and variation of red blood cell indices.

Table 1: Mean±SD of RBC indices, and AST, ALT activity in two phases

Phase 1			Phase 2		
Test	Mean	SD	Test	Mean	SD
AST	22.80	8.80	AST	24.70	10.10
ALT	16.60	8.30	ALT	24.50	13.20
Hb	12.90	1.00	Hb	13.40	1.10
MCV	82.80	7.10	MCV	80.30	6.70
RBC	5.09	0.65	RBC	5.27	0.60
ALB	4.51	0.41	ALB	4.01	0.78
HCT	40.90	3.20	HCT	42.10	3.30
MCHC	30.80	2.00	MCHC	31.80	1.20
MCH	26.00	2.80	MCH	25.60	2.60

Table 2: The analytical results of RBC indices and AST, ALT activity in two phases

Parameters	Paired differences			95% Confidence interval of the difference		t	df	Sig. (2-tailed)
	Mean	SD	SEM	Lower	Upper			
Pair 1 AST1-AST2	-1.9048	11.67533	1.47095	-4.8452	1.0356	-1.295	62	0.200
Pair 2 ALT1-ALT2	-7.9524	11.84501	1.49233	-10.9355	-4.9693	-5.329	62	0.000
Pair 3 ALB1-ALB2	0.4920	0.85960	0.10830	0.2570	0.7080	4.542	62	0.000
Pair 4 HB1-HB2	-0.4873	0.81705	0.10294	-0.6931	-0.2815	-4.734	62	0.000
Pair 5 MCV1-MCV2	2.5079	1.89118	0.23827	2.0316	2.9842	10.526	62	0.000
Pair 6 RBC1-RBC2	-0.1830	0.30118	0.03795	-0.2589	-0.1072	-4.823	62	0.000
Pair 7 HCT1-HCT2	-1.2444	2.53656	0.31958	-1.8833	-0.6056	-3.894	62	0.000
Pair 8 MCH1-MCH2	0.4143	1.54072	0.19411	0.0263	0.8023	2.134	62	0.037
Pair 9 MCHC1-MCHC2	-0.9921	1.83877	0.23166	-1.4552	-0.5290	-4.282	62	0.000

The work experience of employee was between zero and seven years. (Mean 2.56±1.96). The employee according to the working history were divided into four groups as follow: 13 persons (20.6%) less than one year, 19 persons (30.2%) 1-3 years, 19 persons (30.2%) 3-5 years and 12 persons (19%) more than 5 years. Work history and variations in blood indices was not significant statistically. Liver function tests and red blood cell indices in the two phases are presented in Table 2.

DISCUSSION

In this study, the hematological indices were changed accordingly by the pesticides. RBC, MCHC, HCT and Hb level increased, MCV and MCH were decreased. These facts show that toxins and related agents have effects on blood cells as well as RBC indices. This variation can be used as a screening tool and the patients' status of health. Due to the errors which were observed in the electronic instrument in MCHC index, variation in MCHC is not a proper judgment in such studies. The reduction in MCV and increase in RBC and HCT in this study are similar to the effect of toxification of heavy metals (Zabinski *et al.*, 2000). Which indicating that there is a probably a similar mechanism of toxification between the pesticide and heavy metal intoxications on the blood indices. The results from this study are also similar to a study in Germany which showed the effect of lead on some of hematological indices in the children, in this report it was shown that the rate of RBC increase and the MCV, MCH level are reduced (Jacob *et al.*, 2000).

Theoretically, the reduction in MCV and MCH can be related to the some disruption in the pathway of RBC synthesis. It is expected that in the toxification, this disruption can be implemented on some elements of mitochondrial heme biosynthesis and some disturbance on the globin gene structure and ribosomal agents. It should be mentioned that the regulating factor in hemoglobin synthesis is due to negative feed back inhibition of aminolevulinic acid which may disrupted by the toxic agents. The reduction in MCV and MCH

explainable but the increase in RBC and HCT is not possible theoretically. In case of reduction in MCH level due to compensation mechanism, it is possible to increase in RBC count seen in some Hb patients.

In condition which is related to the globin disruption, the reduction of MCV, MCH, are more sever and due to the inhibition of heme synthesis the increase in RBC production cover the globin reduction which ultimately lead to increase in RBC production. In other word in disturbance such as heme biosynthesis inhibition, it is expected that the RBC production either remain constant or reduced, so increase in RBC production is not expected.

The effect of actellic (an insecticide) on a type of fish showed that the rate of RBC, HCT and Hb was significantly reduced by this insecticide in a case-control study (Mgbenka *et al.*, 2005). In other study it was found that cypermethrin (an insecticide) caused a significant reduction in Hb and RBC in rabbits (Yousef *et al.*, 2003). These results are in contradiction with our study.

In this research the increased level of AST, ALT and reduction of albumin, may represent the hepatocellular damage. This abnormally probably occurred through the disturbance of such agents like apotransferrin, apoferritin and also the enzyme responsible in the pathway of hemoglobin synthesis. Apoferritin which is an acute phase protein is increased and subsequently leading to a reduction of Iron turn over from ferritin to the transferrin, also the inhibition of Iron circulation happens predominantly through heme catabolism which takes place through red blood cell disruption, which leads to serum Iron reduction, such status accompanied with anemia, reduction in HCT and RBC.

Although the reduction in MCH and MCV may happen, the increase in HCT level can be due to erythropoietin increase, in such cases in addition to HCT elevation, the Hb level also is increased. The disturbance in heme, anisocytosis and RDW increase can cause a partial increase in HCT which is may be negligible.

Further investigations are required for the accurate assessment of changes by the toxins, morphological study, reticulocyte count, serum Iron, ferritin and erythropoietin levels for differentiation diagnosis can be targets for future investigations.

In an experimental study it was shown that the methidation prescription caused a significant increase in the AST, Alkaline Phosphatase (ALP), Gamma-glutamyltransferase (GGT) and Lactate Dehydrogenase (LDH) compared to the controls. In the later study also it was shown that the ALT level reduced by methidathion (Altuntas *et al.*, 2002). The results from the later investigation are completely different from our study.

In this study, however AST level was increased during a three months study, but this was not statistically significant, but ALT increase was obvious. In study by kalender on Wistar rats it was shown that diazinon (an organophosphate insecticide) caused obvious changes in albumin, AST and ALT level four weeks after taking the toxin (Kalender *et al.*, 2005), which are similar to our findings on the pesticide factory employees.

It seems that RBC indices are useful parameters in investigating the health conditions of worker whom are exposed to pesticide.

ACKNOWLEDGMENT

The authors thank the research deputy of Golestan University of medical sciences for financial support, the medical laboratory sciences department of the University for the assistance in the presenting laboratory tests and Dr. M.H. ALhashem for his kind cooperation.

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