

Original Article

IMPACT OF PESTICIDES ON RENAL FUNCTION TESTS IN COLLABORATION WITH LIVER FUNCTION TESTS AMONG WORKERS OF PESTICIDE FORMULATION AND PACKING PLANTS IN PAKISTAN

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Objective: To evaluate the impact of pesticides on renal function tests in collaboration with liver function tests among workers of pesticide formulation and packing plants in Pakistan.

Material and Methods: One hundred workers, 20-50 years of age, working at different pesticide formulation and packing units for at least one year were included in this study. One hundred healthy age and sex matched industrial workers were taken as controls. Renal function tests i.e. blood urea nitrogen, serum creatinine and liver function tests i.e. alkaline phosphatase, alanine transaminase, aspartate transaminase, gamma glutamyl transferase, total bilirubin, and direct bilirubin, were performed. Screening for hepatitis B and C virus was also done to confirm that all the samples included in current study were negative for Hepatitis B and C virus.

Results: In current study, mean blood urea nitrogen value for 100 control subjects was 8.37 mg/dl while that of 100 pesticide industrial workers was 12.70 mg/dl. Mean serum creatinine value of 100 controls was 0.65 mg/dl and that of patient population was 0.98 mg/dl. These results revealed that all the hundred pesticide industrial workers had normal blood urea nitrogen and serum creatinine levels but on the higher side as compared to control subjects. P value was significantly high. The results of liver function tests in serum samples of control subjects were within normal range. Liver function tests of 80 pesticides industrial workers out of 100 were within normal range whereas 20 workers had abnormally raised levels.

Conclusion: Pesticide exposure among workers of pesticide plants might cause liver toxicity.

Key words: Pesticide industrial workers, Renal Function Tests, Liver Function Tests.

Introduction

Pesticide is defined as any substance intended for preventing, destroying, attracting, repelling or controlling any pest including unwanted species of plants or animals during production, storage, transport, distribution and processing of food, agricultural commodities or animal feed.¹

The increasing and injudicious use of chemical pesticides is recognized to be a potential hazard to both humans and animals.² Presently on an average, fifty thousand tons of pesticides are used in Pakistan annually.³ Number of local pesticide formulation and repacking plants has also increased considerably, according to the increased need. About 70% of the total pesticides are formulated locally.

A large number of workers are directly exposed to pesticides at formulation or repacking plants. These workers are not aware of the hazardous effects of these pesticides and therefore handle the pesticides in a casual way without following any safety measures. Functions of different body organs including liver and kidneys maybe disturbed due to exposure to pesticides.⁴

Liver is one of the most important organs in the human body. Liver functioning is evaluated on the

basis of levels of different enzymes in the blood, i.e. alkaline phosphatase (ALP), alanine transaminase (ALT), aspartate transaminase (AST), gamma glutamyl transferase (GGT), total bilirubin (TBil) and direct bilirubin (DBil).⁵ The kidneys are vital organs that perform a variety of important functions. In a clinical laboratory, blood urea nitrogen (BUN) and serum creatinine (Cr) are used in assessment of renal function.

Significant negative impact of pesticide exposure on various liver and renal functions in human beings has been reported by many researchers. Azmi *et. al.* (2005), at Baqai University, Karachi studied the effect of pesticide residues on general health and different enzyme levels, in the blood of farmers from Gadap (rural area) Karachi. A significant increase in ALP, ALT and AST levels was reported.⁶

Ozucelik DN *et. al.* (2004), Department of emergency medicine Hacettepe university Ankara, Turkey, reported a case of toxicity following unintentional Dichlorodiphenyltrichloroethane (DDT) ingestion, the patient developed severe metabolic acidosis and acute renal failure (ARF) which was diagnosed on second day of ingestion with a BUN level of 47 mg/dl and Cr level of 6.4 mg/dl.⁷

High levels of ALP, ALT, AST and low level of GGT were also reported by Naqvi *et. al.* in the blood of farm workers from Gadab in Pakistan during 2007.⁸

Safety standards for workers at pesticides formulation and repacking plants in Pakistan generally do not meet with the international standards. Now when the pesticide formulation industry is expanding at a rapid pace, health of the workers must be safeguarded. Assessment of different liver and renal function tests are an important tool to assess the impact of exposure of workers to pesticides.

Review of literature has shown that a number of studies have previously been conducted regarding the effect of pesticides on farmers but not in the workers of pesticides industry who are continuously exposed to the pesticides. Keeping in view the importance of the subject, present study was designed to evaluate impact of exposure to pesticides on different liver and renal function tests among workers of pesticide formulation and packing plants in Pakistan.

Materials and Methods

In this cross-sectional, case control study, one hundred workers in the age group of 20-50 years working at different pesticide formulation and packing units for at least one year were included.

One hundred healthy age and sex matched workers (other than pesticide workers) with no history of exposure to pesticides were taken as control.

Individuals, who were known diabetic, hypertensive, smoker, obese, having previous history of jaundice or positive cases of hepatitis B or C were excluded from the study. 6-8 ml of blood samples were drawn and brought to the laboratory. Sera were immediately separated by centrifugation at 3000 rpm for five minutes and were transferred to eppendorf tubes and kept frozen at -2 to -4°C.

Biochemical tests ALP, ALT, AST, GGT, TBil, DBil, BUN and S. Cr were estimated on Dade Dimension RxL (Siemens Healthcare Diagnostic Inc. Delaware, USA) fully automatic clinical chemistry analyzer. Screening for hepatitis B and C virus was done by immunochromatographic technique.

Results of BUN and S. Cr were expressed as mean \pm SD. Data was analyzed by using SPSS version 18. A p value of less than 0.05 was considered statistically significant.

Results

Data of 100 pesticides industrial workers were

taken and it was found that LFTs of 80 workers out of 100 were within the normal range whereas 20 workers had abnormally raised level of LFTs. The results of LFTs in serum samples of control subjects were within normal range. The results of RFTs of all the control subjects as well as pesticide industrial workers were within the normal range. Results are summarized in **table no 1,2.**

Renal Function Tests:

Blood Urea Nitrogen

Normal range for BUN in serum is 5 to 18 mg/dl. In current study, mean BUN value for 100 control subjects was 8.37 mg/dl \pm 1.74 (**Table 1**). Regarding 100 pesticide industrial workers mean BUN value was 12.70 mg/dl with SD \pm 2.28 and 95% confidence interval of 8.15 to 17.25. The aforesaid mean BUN value was within normal range but slightly on the higher side. Out of above 100 pesticide industrial workers, 80 workers (having normal LFT's level) had mean BUN level of 12.77 mg/dl, \pm 2.31 which was slightly on the higher side as compared to control workers group (**Table 2**). Mean BUN value for rest of 20 pesticide industry workers (having abnormal LFT's level) was 12.40 mg/dl \pm 2.16 (**Table 2**). P value was significant on comparison of control group with both pesticide industrial workers group having normal and abnormal LFT's (**Table 2**). On the other hand P value was not significant on comparison of both pesticide industrial workers group having normal and abnormal LFT's.

Serum Creatinine

Normal values of Cr are 0.5 to 1.3 mg/dl. In current study, serum of 100 control subjects indicated mean Serum Creatinine value of 0.65 mg/dl \pm 0.15 (**Table 1**). Mean Serum Creatinine value for 100 pesticide industrial workers was 0.98 mg/dl \pm 0.13 with SD \pm 0.98 and 95% confidence interval of 0.73 to 1.25, which was within normal range but on the higher side. Out of 100 pesticides industrial workers mean Serum Creatinine level for 80 workers (having normal LFT's level) was 0.96 mg/dl \pm 0.11 i.e. within normal limits (**Table 2**). Mean Serum Creatinine value for rest of 20 industrial workers (having abnormal LFT's level) was 1.06 mg/dl \pm 0.15 (**Table 2**). P value was significant on comparison of control group with both pesticide industrial workers group having normal and abnormal LFT's.

Discussion

The present study was carried out to evaluate the impact of exposure to pesticides on LFT's and RFT's among workers of pesticides industry. It was observed that the entire control group had LFT's

Table-1: Pesticide Industrial Workers having normal and abnormal LFT's jointly.

RFT's	Control Subjects (n=100)			Pesticide industrial workers (n=100)		
	Mean	±SD	C.I 95%	Mean	±SD	C.I 95%
BUN (mg/dl)	8.37	1.74	802 - 8.71	12.7	2.28	8.15 - 17.25
S.Cr (mg/dl)	0.65	0.15	0.63 - 0.68	0.13	0.13	0.73 - 1.25

Table-2(a): Pesticide Industrial workers having normal LFT's(n=80).

RFT's	Control Subjects (n=100)		Pesticide industrial workers		
	Mean	±SD	Mean±SD	C.I 95%	P value
BUN (mg/dl)	8.37	1.74	12.71± 231	3.08-4.99	P<0.00
S.Cr (mg/dl)	0.65	0.15	0.96 ± 0.11	0.27-0.33	P<0.00

Table-2(b): Pesticide Industrial workers having abnormal LFT's(n=20).

BUN (mg/dl)	8.37	1.74	12.4± 2.16	3.15-4.91	P<0.00
S.Cr (mg/dl)	0.65	0.15	1.06± 0.15	0.10-0.71	P<0.00

And RFT's not only within normal limits but also on the lower side of normal levels. Out of 100 pesticide industry workers, blood samples of 80 workers showed normal level of LFT's and RFT's, however, slightly on the higher side except GGT which was slightly on the lower side as compared to control subjects. Other 20 pesticide industry workers had raised levels of ALP, ALT and AST whereas GGT level was slightly on the lower side but within normal range and the other tests i.e., TBil, DBil and RFT's were within normal range but close to upper limits of normal levels. High ALP level in serum has also been reported by previous researchers such as Srivastave et. al. (1991),⁹ Paulino et. al. (1996),¹⁰ Srivastava and Malik (2000),¹¹ Mani et. al. (2001),¹² Altuntas et. al. (2002),¹³ and Kaur and Dhanju (2004)¹⁴ in personnel involved in spraying. High level of ALT and AST has also been noted in the serum of the persons exposed to pesticides by different research scientists; Misra et. al. (1985),¹⁵ Carvalho (1991),¹⁶ Kossmann and Magner (1992),¹⁷ Katoh et. al. (1998),¹⁸ Kacker et. al. (1999),¹⁹ Venkaterswarlu et. al. (2000),²⁰ El-Sakka et. al. (2002),²¹ Sahin et. al. (2002),²² Rahman and Siddiqui (2003),²³ Choudary et. al. (2003),²⁴ Kaur and Dhanju (2004).¹⁴ In Pakistan, studies have been conducted by Naqvi et. al. (2007)⁸ at Karachi and they reported that there was significant increase in the liver enzyme levels in the persons exposed to pesticides and they complained about liver and kidney dysfunction and respiratory tract infection. Also target persons of above research work were the males/females involved in spraying of

pesticides in the field. However, the complaints reported by spraying personnel were more than the complaints from the workers of current study. This is probably due to higher exposure of the farmers and spraying personnel to pesticides, as pesticides become more volatile with addition of water. High level of GGT was not observed in any pesticide industry worker. In current study low level of GGT in serum of pesticide industry workers as compared to control subjects was noted. However, GGT level was within the normal range. This Lower Level of GGT probably showed that these workers were exposed directly to the pesticides. Above results are in conformity with the findings of Enan et. al. (1992),²⁵ Garcia and Mourelle (1984)²⁶ and Ranjbar et. al. (2002)²⁷ who reported low level of GGT in various persons exposed to different pesticides or involved in pesticide spraying. TBil and DBil in both groups were not only within the normal range but were also comparatively close to upper normal limit in pesticide industrial workers. High Bilirubin level after exposure to pesticides has also been reported in previous studies by Queoraz ML et. al. (1998),²⁸ Kacker R et. al. (1999),¹⁹ Azmi et. al. (2005).⁴ RFTs i.e., BUN and Creatinine of all the 100 pesticides workers were found to be within normal range but on the higher side as compared to control subjects. It was also observed that in chronic exposure there was no significant change but acute severe exposure led to acute renal failure, as was reported in a case in Turkey following unintentional DDT ingestion, where the patient developed severe metabolic acidosis and acute renal failure.⁷

Conclusion

Pesticide exposure among workers of pesticide plants might cause liver toxicity.

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