Comparative Study of Paraoxonase and Cholinestrase Enzymes Activities in Diagnosis of Organophosphorus Insecticide Intoxication

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Abstract   Many efforts have been made to evaluate organophosphorus (OP) toxicity by sensitive biomarkers. Therefore, the aim of this work is to evaluate cholinesterase and paraoxonase (PON1) enzymes activities as diagnostic tools in acute & chronic organophosphorus toxicity with poisoning severity assessment. The present study was conducted on 90 adult men after taking their informed consent, they were divided into three groups; group (I) included thirty patients who were acutely exposed to organophosphorus insecticides (OPI). Group (II) included thirty farm workers chronically exposed to OP. Group (III) included thirty healthy matched volunteers served as control group. The severity of symptoms and signs of acute OP poisoning was graded into mild, moderate and severe grade. Long term pesticide exposure intensity was estimated depending on mixing, application methods, repair activities and use of personal protective equipment (PPE). Exposure intensity score = (Mix + Apply + Repair) x PPE. Butyrylcholinesterase (BuChE), acetylcholinesterase (AChE) and paraoxonase (PON1) enzymes activities were determined. The result of the current study revealed significant decrease in BuChE, AChE and PON1 in groups I and II when compared to group III. Moreover, BuChE and AChE enzymes were significantly decreased in group I when compared to group II. Significant positive correlation was detected between AChE enzyme activity and both BuChE and PON1 enzymes activities in group I. However, group II showed significant positive correlations between BuChE enzyme activity and the activity of each of AChE and PON1. Moreover, there was significant decrease in AChE enzyme activity in severe cases compared to mild and moderate cases in group I. Nevertheless, group II registered significant decrease in BuChE, AChE and PON-1 when Pesticide Exposure Intensity Score is more than 10.

Introduction

Organophosphorus compounds (OPCs) are extensively used in agricultural and household environments to control insects and pests. Because of their wide spread use and easy accessibility, OP toxicity is an important global health problem especially in developing countries (Buyukokurog et al., 2008). In Egypt, organophosphorus intoxication is a common cause of morbidity and mortality. It represents more than 50% of insecticide poisoned patients (Ibrahim et al., 2011).

Organophosphorus compounds act as powerful acetylcholinesterase enzyme (AChE) inhibitors, resulting in acetylcholine accumulation and overstimulation of cholinergic synapses, neuromuscular junction and central nervous system.

The cholinergic overload leads to characteristic muscarinic, nicotinic and central nervous system symptoms and signs (Exner and Ayalar, 2009).

Diagnosis is based on clinical suspicion, the characteristic clinical signs, smell of pesticides or solvents and reduced butyrylcholinesterase or acetylcholinesterase activities in the blood (Eddleston et al., 2008). Therefore, blood cholinesterase enzymes activities have become relatively simple assessing procedure for OP human exposure extent. Such assays are considered as diagnostic tool rather than prognostic one (Kamanyire and Karalliedde, 2004).

Butyrylcholinesterase enzyme is more sensitive than AChE as the plasma cholinesterase enzyme is the first binding site of OPCs following their

absorption (Makhaeva et al., 2009). However, acetylcholinesterase is more specific than BuChE , as, it is inhibited in a parallel manner to neuronal AChE (Jintana et al., 2009).

Individual susceptibility and exposure level have been reported to play a critical role in OP exposure outcome. Individual susceptibility is controlled by several polymorphic key enzymes such as plasma paraoxonase (PON1) enzyme (Hernandez et al., 2005).

Paraoxonase (PON1) is a high density lipoprotein-associated enzyme which is capable to hydrolyze multiple substrates including aromatic carboxylic acids, nerve gases and several organophosphorus metabolic products. Paraoxonase enzyme displays several polymorphisms that influence both its level and catalytic activity. Therefore, it could be considered as a good indicator to assess organophosphorus detoxification rate, poisoning severity and consequently susceptibility to develop organophosphorus poisoning (Costa et al., 2008).

Since paraoxonase is considered a biomarker of susceptibility to organophosphorus poisoning, and cholinesterase enzymes are accepted as biomarkers of organophosphorus exposure, the goal of the current study is to evaluate cholinesterase and paraoxonase (PON1) enzymes activities as diagnostic tools in acute and chronic OP exposures with poisoning severity assessment.

Patients and methods

This randomized cross sectional comparative study was performed at Poison Control Unit, Tanta University Emergency Hospital. It was approved by the Research Ethical Committee, Faculty of Medicine, Tanta University.

Patients included in this study were acutely and chronically exposed to organophosphorus insecticides (OPI). Patients with any pre-existing chronic diseases including; hypertension, diabetes, hepatic, renal, cardiovascular diseases and cancer were excluded. Written informed consent was obtained from each patient.

Ninety adult male patients and volunteers have participated in the study. They were grouped into group I, included thirty acutely OP poisoned patients, group II, included thirty farm workers chronically exposed to organophosphorus compounds and group III, included thirty healthy adult volunteers matched for age and socioeconomic level.

Diagnosis of acute organophosphorus poisoning (OPP) was based on history of OP insecticides exposure, characteristic OPP symptoms and signs, clinical improvement after atropine and oximes (toxogonin) administration and decrease in serum or RBCs cholinesterase enzymes activities (Karki et al., 2004). Sociodemographic data (age, occupation, education, residence, marital status and special habits) were registered.

Chlorpyrifos, Profenofos and malathion were the most commonly OP compounds to which the patients were exposed in both acute and chronic OP exposures. The severity of symptoms and signs of acute OPP was graded according to Minton and Murray (1988) into: *Mild grade OPP:* Fatigue, headache, blurred vision, dizziness, nausea, vomiting, excessive sweating, salivation, abdominal pain and tightness in chest. *Moderate grade OPP*: Symptoms of mild poisoning plus muscular fasciculation, weakness, inability to walk and miosis. *Severe grade OPP:* Symptoms of moderate poisoning plus unconsciousness, flaccid paralysis, respiratory distress, cyanosis and marked miosis with loss of pupil reflexes.

Long term pesticide exposure intensity was estimated according to Dosemeci et al. (2002). It is based on four basic variable i.e. mixing, application methods, repair activities and use of personal protective equipment (PPE). Exposure intensity score = (Mix + Apply + Repair) x PPE. After calculation, the pesticides applicators were categorized according to Coble et al. (2005) into < 5 for low exposure, 5-10 for medium exposure and > 10 for high exposure.

Venous blood sample (5ml) was collected from all subjects immediately after admission and before administration of any medication and was divided into 2 portions. The first portions (3ml) was centrifuged for 10 min at 2500 r.p.m. Serum was collected and kept at -20◦C until assay of paraoxonase and butyrylcholinesterase activities. The second portion of blood (2ml) was collected in EDTA tube for assay of erythrocyte cholinesterase activity.

Butyrylcholinesterase and acetylcholinesterase enzyme activities were determined by using colorimetric method according to Ellman et al. (1961) by using butyrylthiocholine iodide (Aldrich Chemical Co-Ltd., England) and acetylthiocholine iodide as substrates (Sigma- Aldrich, Chemical Company, USA). Paraoxonase enzyme activity was determined colorimetrically by using paraoxon (O,O-diethyl O-p-nitrophenyl phosphate; (Sigma- Aldrich, Chemical Company, USA) according to the method of Furlong et al. (1988). Hemoglobin was determined according to Hall and Malia (1991) by using kits obtained from Biodiagnostic Co. Ltd., Egypt.

Results were tabulated and statistical analysis was performed with Statistical Package for the Social Science (SPSS) version 17 computer program (Landau and Everitt, 2004). Analysis of data was done by Chi-square. Comparison between the studied groups was performed with one way ANOVA (F-testing). Correlation between variables was evaluated using Pearson correlation coefficient. The level of statistical significance was set at p value below 0.05.

Results

Table (1) illustrates sociodemographic data of the three studied groups. There was significant difference in occupational and smoking distribution among the

studied groups. Farm workers represented 40% of group I and all members of group II. Concurrently, non smokers represented a peak (83.33%) in group I and smokers represented another peak (70%) in group II.

Grading of toxicity in acute organophosphorus exposure revealed that 12 patients (40%) were evaluated as mild acute OPP, while 10 patients (33.33%) were graded as moderate acute OPP and 8 patients (26.67%) belonged to the severe grade. The mean of Pesticide Exposure Intensity Score (PEIS) in chronic organophosphorus exposure (group II) was 9.58±2.79 (range from 1.2 to 14). Seventeen subjects (56.67%) were highly exposed; they have shown PEIS of more than 10. While 11 subjects (36.67%) registered PEIS from 5-10, and 2 subjects (6.67%) had PEIS less than 5.

Analysis of cholinesterase and paraoxonase enzymes activities revealed significant decrease in BuChE, AChE and PON-1 in groups I and II when compared to group III. Moreover, BuChE and AChE enzymes were significantly decreased in group I when compared to group II (Table 2).

In group I, significant positive correlation could be detected between AChE enzyme activity and each of BuChE and PON1 enzymes activities (Figures 1&2). However, no significant correlation was found between PON-1 and BuChE enzymes activities (p=0.098, r=0.341).

Regarding group II, significant positive correlations were noticed between BuChE enzyme activity and the activity of each of AChE and PON1 enzymes activities (Figures 3&4). On the other hand, no significant correlation was detected between PON-1 and AChE enzymes activities (p=0.253, r=0.215).

Table (3) shows significant decrease in AChE enzyme activities in severe cases compared to mild and moderate cases in group I. However, the severity grade didn't significantly affect the BuCh and PON-1 enzymes activities. Nevertheless, group II registered significant decrease in BuChE, AChE and PON-1 when Pesticide Exposure Intensity Score is more than 10 (Table 4).

Table (1): Chi-Square analysis of sociodemoraphic data among the three studied groups.

Sociodemoraphic data	Groups (No, %)				Chi-Square	
	Group I n=30	Group II n=30	Group III n=30	Total	X^2	P-value
(1) Age groups						
<20	2 (6.67%)	0 (0%)	2 (6.67%)	4 (4.44%)	9.93	0.26
20-30	11 (36.67%)	4(13.33%)	9 (30%)	24 (26.67%)		
30-40	10 (33.33%)	13 (43.33%)	9 (30%)	32 (35.56%)		
40-50	3 (10%)	7 (23.33%)	6 (20%)	16 (17.78%)		
>50	4 (13.33%)	6 (20%)	4 (13.33%)	14 (15.56%)		
(2) Occupation						
Manual worker	5 (16.67%)	0 (0%)	20 (66.67%)	25 (27.78%)	93.92	0.001*
Unemployed	10 (33.33%)	0 (0%)	8 (26.67%)	18 (20%)		
Student	1(3.33%)	0 (0%)	2 (6.67%)	3 (3.33%)		
Farm worker	12 (40%)	30 (100%)	0 (0%)	42 (46.67%)		
Employer	2 (6.67%)	0 (0%)	0 (0%)	2 (6.67%)		
(3) Residence						
Rural	22 (73.33%)	28 (93.33%)	24 (80%)	74 (82.22%)	4.25	0.11
Urban	8 (26.67%)	2 (6.67%)	6 (20%)	16 (17.78%)		
(4) Education						
Illiterate	10 (33.33%)	12 (40%)	4 (13.33%)	26 (28.89%)	11.56	0.07
Low	2 (6.67%)	2(6.67%)	0 (0%)	4 (4.44%)		
Moderate	16 (53%)	13 (43.33%)	24 (80%)	53 (58.89%)		
High	2 (6.67%)	3 (10%)	2 (6.67%)	7 (7.78%)		
(5) Marital state						
Married	15 (50%)	22 (73.33%)	19 (63.33%)	56 (62.22%)	3.49	0.17
Single	15 (50%)	8 (26.67%)	11(36.67%)	34 (37.78%)		
(6) Special habits						
Smokers	5 (16.67%)	21(70%)	10 (33.33%)	36 (40%)	18.61	<0.001*
Non- smokers	25 (83.33%)	9 (30%)	20 (66.67%)	54 (60%)		
Total	30 (100%)	30 (100%)	30 (100%)	90 (100%)		

Table (2): ANOVA and TUKEY'S test analysis of enzymes activities in the three studied groups.

	Group I n=30	Group II n=30	Group III n=30	ANOVA		TUKEY'S test		
				F	P-value	Group I & III	Group II & III	Group I & II
Butyrylcholinesterase (U/L)								
Range	830.88- 6250	1470-5588.23	2941.17-5220.58	17.7	<0.001*	<0.001*	0.04*	0.001*
Mean±SD	2302.26±1191.48	3265.09±1164.68	3868.34±616.01					
Acetylcholinesterase (U/gHb)								
Range	4.54-20.70	5.51-28.64	14.32-28.01	32.4	<0.001*	<0.001*	<0.001*	0.004*
Mean±SD	12.06±4.38	16.43±6.56	22.55± 3.83					
Paraononase (U/ml)								
Range	5.88-90.97	16.05-132.18	42.81-148.23	13.3	0.001*	<0.001*	0.01*	0.08
Mean±SD	49.56±24.36	65.94±30.36	88.35± 32.17					

Significant at p-value<0.05; n=30 for each group

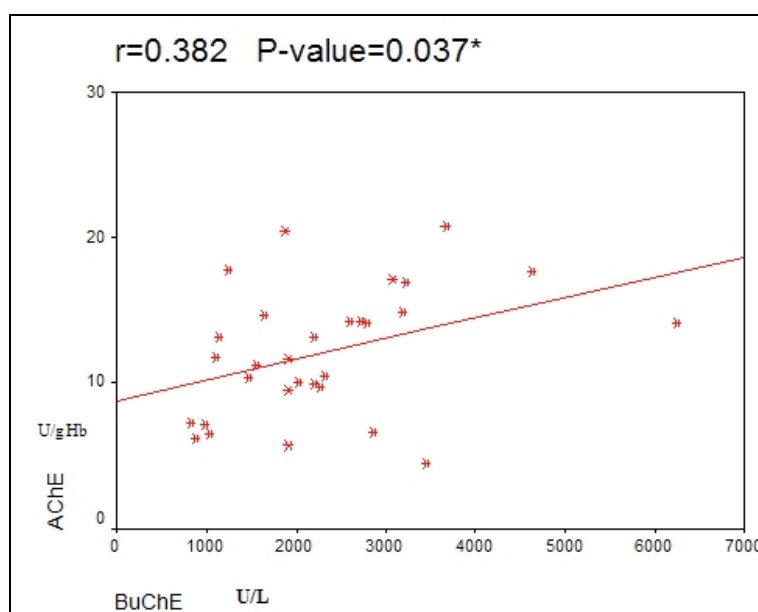**Table (3): ANOVA test analysis of enzymes activities and grades of severity in group I.**

Group I enzyme activities	Mild (n=12)	Moderate(n=10)	Severe(n=8)	ANOVA	
	Mean± SD	Mean± SD	Mean± SD	F	P-value
BuChE (U/L)	2867.17±1300.48	1566.91±674.27	2374.08±1146.15	3.02	0.06
AChE (U/gHb)	14.33±2.92	11.18±4.94	9.74±4.31	3.40	0.04*
PON1 (U/ml)	59.43±20.57	46.34±24.30	38.79±26.85	1.97	0.15

Significant at p-value<0.05

Table (4): ANOVA test analysis of enzymes activity and Pesticides Exposure Intensity Score in group II

Group II enzymes activities	Pesticides Exposure Intensity Score			ANOVA	
	<5	5-10	>10		
	Mean± SD	Mean± SD	Mean± SD	F	P-value
BuChE (U/L)	3724.26±67.59	3529.41±1329.23	3040.05±1107.19	2.78	0.048*
AChE (U/gHb)	20.66±6.87	14.33±5.28	11.02±1.41	4.84	0.01*
PON1(U/ml)	123.88±11.73	62.89±22.42	60.13 ±33.62	5.01	0.01*

Significant at p-value<0.05

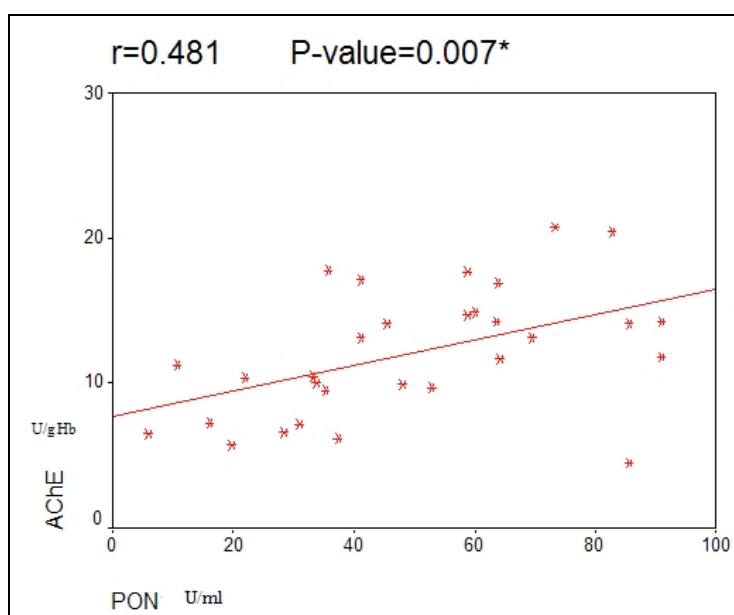**Fig (1): Pearson correlation between AChE and BuChE enzymes activities in group I patients**

r=0.481   P-value=0.007*

Fig (2): Pearson correlation between AChE and PON1 enzymes activities in group I patients.
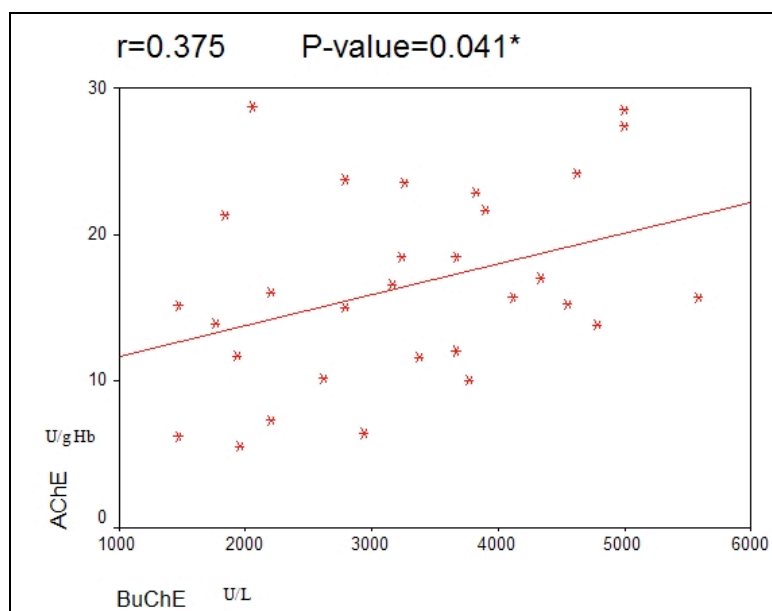
r=0.375   P-value=0.041*

Fig (3): Pearson correlation between BuChE and AChE enzymes activities in group II farm workers.
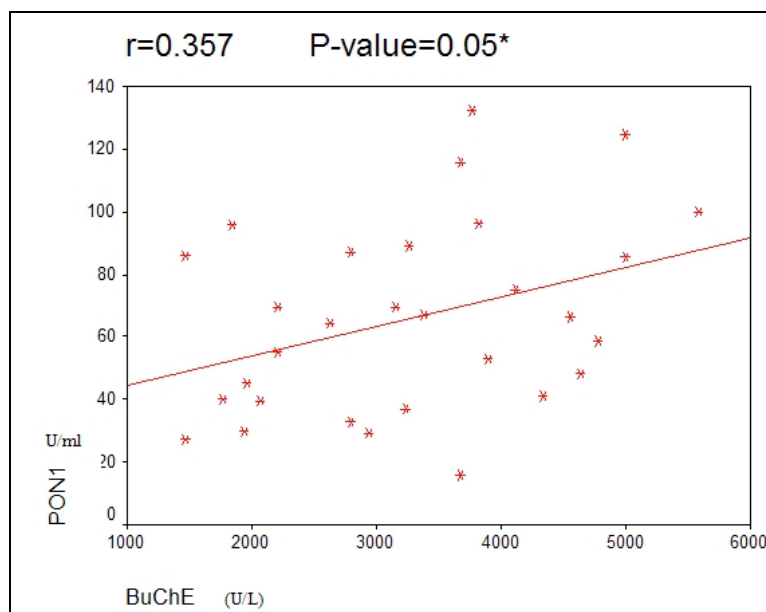
Fig (4): Pearson correlation between BuChE and PON-1 enzymes activities in group II farm workers.

Discussion

This randomized cross sectional comparative study was performed to evaluate cholinesterase and paraoxonase (PON1) enzymes activities as diagnostic tools in acute and chronic OP exposures with poisoning severity assessment.

Results obtained in this study from group I patients revealed that the mean age was 31.76± 11.93 years and 36.67% were between 20-30 years. In addition, 40% of acute OP poisoned patients were farm workers which could be attributed to the wide spread OPCs accessibility during working in agriculture with misuse of protective devices (Magauzi et al., 2011; Mishra et al., 2012). These results coincide with the results recorded by Gannur et al. (2008) and Shah Harsh et al. (2012) who reported that the majority of acute OP poisoned patients were between 21-30 years and the greater part of patients were agriculture workers.

Accordingly, 73.33% of patients in group I were recorded from rural areas. So, it could be explained by widespread use of OPCs in the rural agricultural society in the Delta region together with its low cost. These findings were in the same line with other studies (Gannur et al. 2008; Patel and Tekade 2011).

The low level of education in farm workers constitutes a risk factor for OPP being unable to read and follow the safety instructions for pesticides use. A fact that comes in line with the results of the current study, where 53.33% of group I patients were moderately educated and 33.33% were completely illiterate. Similar finding were recorded by Nigam et al. (2004) in Bhopal region.

Results obtained in this study from group II Egyptian farm workers revealed that, the mean age was

40.03± 9.06 years and 43.33% of subjects were between (30-40 years). Likewise, a study in Thailand by Jintana et al. (2009) reported that the mean age of exposed farm workers was 39.9 ± 1.13 years and 32.22% of cases were between (36-45 years). In the present study, 43.33% of farm workers were moderately educated. This finding shows consistency with those obtained by Hofmann et al. (2010) and Imran and Dilshad (2011).

The current study reported significant decrease in BuChE and AChE activities in groups I and II when compared to control group. Previously, BuChE and AChE activities were recorded to be significantly decreased in both acute and chronic OP exposures (Brahmi et al., 2006; Sozmen et al., 2007; Chakraborty et al., 2009; Prabodh et al., 2012).

In the present study, BuChE and AChE were significantly decreased in group I when compared to group II. This finding can be explained on the basis that in acute OP exposure, there is marked phosphorylation of ChE under the influence of the high dose of OP exposure in a very short time. On the other hand in chronic OPP, there is exposure to low dose of OP over a long time (Jokanovic and Stojiljkovic, 2006; Balali-Mood and Balali-Mood, 2008). Chronic OP exposure is irregular that may give enough time for ChE recovery. However, such recovery may be incomplete particularly in Egyptian farmers as they are regular sprayers in the three agricultural seasons.

Controversial results were reported by Smit et al. (2003), who demonstrated that AChE activity registered significant decrease during high exposure period and significant increase during low exposure period in Sri Lankan farmers. They interpreted these findings by the different exposure degrees as Sri

Lankan farmers are irregularly sprayers, therefore, there was enough time for cholinesterase enzyme adaptation or compensation during low exposure period that increase the cholinesterase production with subsequent central muscarinic and nicotinic receptors down regulation (Ciesielski et al., 1994). However, such compensation doesn't occur in Egyptian farmers because they are regular sprayers in every agricultural season. So, there is no enough time for enzyme adaptation to occur. In other words, the nonstop exposure of Egyptian farmers to OPCs is considered to be responsible for continuous inhibition of cholinesterase enzymes.

Moreover, the present study demonstrated significant positive correlation between BuChE and AChE activities in groups I and II. This finding is in agreement with other studies carried out by Akgur et al. (2003) and Joshaghani et al. (2007). However, Thetkathuek et al. (2005) demonstrated significant decrease in BuChE without alteration in AChE activity in chlorpyrifos applicators. Eaton et al. (2008) stated that, plasma BuChE is substantially more sensitive to inhibition by chlorpyrifos than erythrocyte AChE. In the present study, farm workers used a mixture of different OPCs which may together display different degrees of cholinesterase enzymes inhibition.

The present study showed an inhibition in PON1 in group I (about 44%) as compared to control group. This finding was consistent with Sozmen et al. (2002) who observed that 30% of PON1 activity was lower in acutely OP exposed patients than control. Conversely, Tanrisev and Toprak (2004) didn't report any significant difference in PON1 activity in acutely OP poisoned patients.

Moreover, the current study observed significant decrease in PON1 in subjects of group II (about 30%) when compared to control group. This finding shows consistency with other studies carried out by Hoffmann et al. (2009) and Singh et al. (2011). However, Sirivarasai et al. (2007) and Zhou et al. (2007) didn't notice any significant change in PON1 activity between OP chronically exposed subjects and control.

The OP induced decrease in PON1 activity may be due to direct inhibition without affecting enzyme synthesis or clearance. The mechanism by which OPCs may inactivate PON1 is still in debate. However, it may be due to a competitive effect of the intoxicating OP during the in vitro assay (Sozmen et al., 2002), or due to the metabolic activation of OPCs to highly reactive intermediates which might account for the decreased PON1 activity by oxidative stress challenge (Hernandez et al., 2008). Furthermore, PON1 activity may not be affected significantly in OP exposed patients who don't have any special genetic susceptibility to OPP (Tanrisev and Toprak, 2004). It is well known that the distribution of the polymorphic alleles of PON1 is a major factor for determining enzyme activity and assessing individuals' susceptibility to OPCs (Costa et al., 2012). The latter theory makes a sense and provides an explanation to the difference in severity of OPP among patients having similar degree of OP exposure.

On the other hand, Hernandez et al. (2004) and Browne et al. (2006) demonstrated higher PON1 level in chronic OP exposed farm workers at post exposure period, which can be attributed to adaptive PON1 response following chronic OP exposure.

The existing study observed significant positive correlation between AChE and PON1 enzymes activity in patients of group I. This finding shows consistency with study in India carried out by Goel et al. (2012). Additionally, studies in transgenic mice have demonstrated that low PON1 activity is associated with greater brain AChE inhibition after chlorpyrifos and diazinon oxon exposures (Li et al., 2000; Cole et al., 2003).

Goel et al. (2012) provided an explanation for the positive correlation between PON1 and AChE on the basis that PON1 can hydrolyze several OPCs oxon derivatives (active form of OPCs), thereby, preventing ChE from inhibition by OPCs. At the same time, paraoxonase enzyme may protect the RBCs membrane from lipid peroxidation through its antioxidant properties (Eskenazi et al., 2010). So, it may decreases or limits the degree of AChE inhibition.

Conversely, Akgur et al. (2003) demonstrated lack of correlation between PON1 enzyme and both cholinesterase enzymes activities in acute OP poisoned patients. It could be attributed to high acute organophosphate exposure that gave little opportunity for paraoxonases to afford much protection than low-level chronic exposure, where additional time for enzymatic detoxification is available.

Moreover, the current study recorded significant positive correlation between PON1 and BuChE activities in group II farm workers. A result which is in accordance with the study carried out by Sozmen et al. (2007), Chia et al. (2009) and Hoffmann et al. (2009) who declared that, BuChE and PON1 activities decreased in parallel manner in farmers after chronic OP exposure when compared to either control or to their baseline levels.

However in the current study, no significant correlation could be observed between PON1 and AChE enzymes activities in group II. While, Singh et al. (2011) found significant positive correlation between AChE and PON1 level in chronic OP exposed farm workers. Hernandez et al. (2005) and Sirivarasai et al. (2007) demonstrated decrease in cholinesterase enzymes without PON1 reduction in chronic OP exposure. Such variation is attributed to PON1

polymorphism among individuals that will affect its level and consequently its catalytic effect on metabolism of active OPCs intermediate with difference in individual susceptibility to OPP.

Significant decreases in enzymes activities were found in subjects of group II who's Pesticide Exposure Intensity Score were more than 10. This finding is parallel with Hofmann et al. (2010) and Sozmen et al. (2007) who observed BuChE inhibition with increasing OPCs exposure score.

Conclusion

The three enzymes AChE, BuChE and PON1were inhibited in both acute and chronic organophosphorus exposure. The degree of inhibition in chronic OP exposure was correlated with the increased pesticides exposure intensity score. On the other hand, AChE activity is much more affected by the severity of acute poisoning.

Recommendations

In the light of the present study, the following recommendations are proposed:

1- Measurement of paraoxonase enzyme activity is recommended to confirm both acute and chronic organophosphorus exposures particularly when measurement of cholinesterase enzymes activity levels are not available.

2- To assess the severity of acute organophosphorus poisoning, acetylcholinesterase enzyme activity level should be measured at hospital admission (The most expensive, most specific and needs more experience).

3- Indirect exposure assessment by using Pesticides Exposure Intensity Score is recommended as it can provide information of the potential hazard to human health especially when measurement of biological markers is not available.

4- Farm workers should be provided with continuous health education programs concerning; hazards of agricultural practices, encouraging them for safe and careful pesticides use, for example; mixing the OP pesticides should be carefully done by a stick or paddle, applying pesticides and repairing equipments should be done properly with adequate personal protective equipments. After spraying OP pesticides, farm workers should take shower and change their clothes. Education of Pesticides Exposure Intensity Score as a self assessment indicator for pesticides exposure.

5- Restricting availability and uncontrolled sale of organophosphorus compounds, banning more toxic ones and using safer pesticides are recommended to reduce the incidence of organophosphorus poisoning.

6- It is recommended to have pre-employment base line and periodic measurement of cholinesterase and paraoxonase enzymes activity levels for farm workers to determine the extent of chronic OPP after exposure.

7- Farm workers should avoid their nonstop exposure to pesticides throughout the year by taking periods of non exposure to offer enough time for their enzymes to recover and return to their normal levels.

8- Further studies are recommended to find the relation between the mode of treatment and enzyme activities.

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الملخص العربي

دراسة مقارنة لأنشطة إنزيمات البارااوكسونيز و الكولين إستيريز في تشخيص التسمم بالمبيدات الحشرية الفسفورية

منى الجوهري[1] و نهلة العشماوي[2] و رباب الكيلاني[1] و أروه أبو الفضل[1] و غادة السرنجاوي[1]

لقد بذلت جهود كثيرة لتقييم سمية المركبات الفسفورية باستخدام مؤشرات حيوية حساسة. لذلك فان هذه الدراسة تهدف إلى تقييم مستوى نشاط أنزيمات الكولين إستيريز و البارااوكسونيز كأدوات تشخيصية في حالات التسمم الحاد و المزمن بالمبيدات الفسفورية العضوية مع تقييم شدة هذا التسمم. تم إجراء هذه الدراسة على تسعين شخص من الرجال وذلك بعد أخذ الموافقة المستنيرة منهم على اجراء البحث، وقد تم تقسيم الأشخاص إلى ثلاث مجموعات: اشتملت المجموعة الأولى على ثلاثين حالة مصابة بتسمم حاد بالمركبات الفسفورية، وشملت المجموعة الثانية ثلاثين شخصا من المزارعين الذين يتعرضون بصورة مزمنة للمركبات الفسفورية العضوية، بينما كانت المجموعة الثالثة عبارة عن ثلاثين حالة من المتطوعين البالغين الأصحاء و التي استخدمت كمجموعة ضابطة. وقد تم تصنيف شدة أعراض وعلامات التسمم الحاد بالمبيدات الفسفورية إلى خفيف ومتوسط وشديد.

وقد قدرت شدة التعرض للمبيدات في الأفراد المعرضين بصورة مزمنة للمركبات الفسفورية العضوية، اعتمادا على عامل الخلط، وأساليب الاستعمال، وإصلاح المعدات واستخدام معدات الوقاية الشخصية. مقياس شدة التعرض للمبيدات= (الخلط + وسيلة الاستعمال + اصلاح المعدات) x استخدام معدات الوقاية الشخصية. وقد تم قياس مستوى نشاط كل من انزيمات البيوتريل كولين إستيريز و الأسيتيل كولين إستيريز والبارااوكسونيز. وقد كشفت الدراسة الحالية عن انخفاض ذي دلالة إحصائية في نشاط كل من انزيمات البيوتريل كولين إستيريز و الأسيتيل كولين إستيريز والبارااوكسونيز في المجموعة الأولى والثانية مقارنة بالمجموعة الثالثة. بالإضافة إلى أن هناك انخفاضا ذا دلالة إحصائية في نشاط البيوتريل كولين إستيريز و الأسيتيل كولين إستيريز في المجموعة الأولى مقارنة بالمجموعة الثانية

وقد تبين وجود علاقة طردية ذات دلالة إحصائية بين انزيم الأسيتيل كولين إستيريز و كل من انزيمات البيوتريل كولين إستيريز والبارااوكسونيز في المجموعة الأولى. في حين أن المجموعة الثانية أوضحت علاقة طردية ذات دلالة إحصائية بين البيوتريل كولين إستيريز وكل من الأسيتيل كولين إستيريز والبارااوكسونيز. علاوة على ذلك فقد لوحظ وجود انخفاض ذي دلالة إحصائية في نشاط انزيم الأسيتيل كولين إستيريز في الحالات الشديدة التسمم مقارنة بالحالات المتوسطة و الخفيفة التسمم في المجموعة الأولى.

و مع ذلك فقد سجلت المجموعة الثانية انخفاضا ذا دلالة إحصائية في نشاط كل من انزيمات البيوتريل كولين إستيريز و الأسيتيل كولين إستيريز والبارااوكسونيز حين كان مقياس شدة التعرض للمبيدات أكثر من 10.

1 قسم الطب الشرعي والسموم الإكلينيكية   كلية الطب   جامعة طنطا
2 قسم الكيمياء الحيوية   كلية الصيدلة   جامعة طنطا